

JPRS-UEE-85-007

15 May 1985

# USSR Report

ELECTRONICS AND ELECTRICAL ENGINEERING

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TRANSPORTATION

UDC 621.331

OUTLOOK FOR USE OF INDUCTION MOTOR AS TRACTION MOTOR IN URBAN TRANSPORTATION

Moscow ELEKTRICHESTVO in Russian No 10, Oct 84  
(manuscript received 6 Mar 84) pp 21-26

YEFREMOV, I. S., doctor of technical sciences, KALOSHKINA, L. S., engineer,  
and KARASEV, S. I., engineer, Moscow Institute of Power Engineering

[Abstract] The four reasons for changing from a d.c. traction motor to an induction motor in urban transportation systems are much higher reliability of a motor with squirrel-cage rather than wound rotor, up to 30% higher energy efficiency with available automatic electronic controls, much lower motor manufacturing cost, and up to 30% size and weight reduction resulting in better iron and copper economy along with lower moment of inertia. These advantages become very obvious in a comparison of typical two 150 kW (1 h duty) trolley-bus motors: an AD 622-4 induction motor weighing 700 kg and a DK-211 d.c. motor weighing 900 kg. The deficiencies of an induction motor for this application are necessity of including a 3- $\phi$  voltage or current inverter, lower ratios of starting torque to weight and of starting torque to starting current, worse regulation characteristics, and difficult rotor-speed control by means of stator-frequency conversion. A traction system with induction motor therefore still needs to be further developed and improved, especially in the area of automatic control. The latter must ensure starting with prescribed acceleration, running with speed stabilization within prescribed limits, it must facilitate phase control and steady loading of motors in multidrive systems, it must satisfy a multitude of special constraints largely sensitive to random influencing factors, and it must provide protection against over-voltage and overload as well as against open circuit and short circuit, against crawling and locking. Research on these problems is underway in the Soviet Union as well as in several West European countries and in Japan. The automatic control system developed at the Moscow Institute of Power Engineering on the principle of rotor speed control through stator frequency-current regulation operates either in the constant-torque mode at low speeds or in the constant-power mode at high speeds. The current control loop includes a current transducer, a mismatch-signal amplifier, a pulse width modulator, and a reversible current regulator. The frequency control loop includes a discrete speed transducer, a frequency adder, a distributor of control pulses to the inverter thyristors, and an autonomous current inverter. Regulation based on

constant rotor flux linkages has yielded much better dynamic characteristics. The system is 25-30% more energy efficient than the conventional resistor-contact system of control. Figures 5; tables 1; references: 2 Russian, [150-2415]

UDC 621.331:621.314.26

# FREQUENCY STABILITY OF OUTPUT VOLTAGE IN AUTONOMOUS ELECTRIC POWER SUPPLIES FOR TRANSPORTATION SYSTEMS

Moscow ELEKTRICHESTVO in Russian No 10, Oct 84  
(manuscript received 29 Aug 83) pp 26-31

IN'KOV, Yu. M., doctor of technical sciences

[Abstract] Autonomous a.c. electric power supplies for transportation systems, specifically trains, are analyzed for frequency stability of the output voltage. Such power supplies usually include an alternator which generates a voltage at a nominal frequency within the 100-400 Hz range, higher than the user frequency and thus requiring conversion. This is usually done by static converters in the form of 3- $\phi$  thyristor bridges, direct frequency conversion with natural current switching being most efficient and economical when the frequency ratio is large. The output voltage of such a converter depends on the mode and the precision of frequency control, on the load impedance angle, and on the converter power circuitry. A typical automatic frequency control and stabilization system is based on monitoring the intersections of phase voltages and beginning of the current commutation at these instants. Such a system has been designed for a GS-507 train alternator. Here a pulse synchronizer connected to the alternator output terminals triggers a master kipp oscillator through an AND gate which blocks subsequent pulses while the oscillator is in the ON state, feedback from the oscillator output to this AND gate allowing the oscillator to return to the initial OFF state after a present time. Output pulses from the kipp oscillator pass through a scaling trigger to form separately positive and negative half-wave current pulses for the 3- $\phi$  thyristor bank. Performance calculations are based on a known speed of the prime mover (diesel engine) as reference. Stability analysis of the output frequency takes into account that variation of the latter is discrete and the input voltage level as well as the load impedance angle are random quantities. The distribution density of converter output frequency is calculated here for a normal distribution and for a uniform distribution of the converter input frequency, over the entire possible range of the latter. Figures 4; references 8: 6 Russian, 2 Western (1 in Russian translation). [150-2415]

UDC 621.316.1:629.7.058.52

COMBINED SELF-CONTAINED POWER SUPPLY SYSTEM FOR FULLY ELECTRIFIED  
TRANSPORTATION FACILITIES

Moscow ELEKTRICHESTVO in Russian No 11, Nov 84  
(manuscript received 22 Mar 84) pp 24-30

MIZYURIN, S. R., REZNIKOV, S. B., BOCHAROV, V. V., ALESHECHKIN, V. A.,  
SMIRNOV, S. V., KONDAKOV, L. I. and TOKAR', I. I., Moscow

[Abstract] Because of some characteristic features of hydraulic and pneumatic machinery, such as size, efficiency, operating cost or suitability to particular environmental conditions, electrical machines must be used with the transportation facility. When the energy consuming devices, other than propulsion providing units are supplied by a single source, the transport facility is called fully electrified. Self-contained high-efficiency sources for fully electrified facilities are being intensively developed in the USSR as well as abroad consisting of three basic types: ac 115-120V, 400 Hz generators; 270 V dc generators; and the combination of the other two. The structure of the proposed combination electric power source was examined, which differs from the standard because of a three-phase trapezoidal low-frequency pulsing voltage with uniform phase-shift interval and starts propulsion units with three-phase alternating sinusoidal voltage with stable frequency. Since a quantitative analysis of the efficiency is possible only for a specific case, a qualitative analysis was made of the combination system which was found to better satisfy the fundamental requirements for the electric power sources of fully electrified transportation facilities because of the reduction in secondary power sources, greater simplicity and total power-generating capacity, and suitability for conversion to a dc system with higher voltage. The three-wire distribution of the high voltage dc power with intervals in each wire allows for simplifications of the switching equipment, reduced arcing and electrical starting of the propulsion plants. Figures 2; references 5: 2 Russian, 3 Western.  
[160-12755]

UDC: 621.314

ENERGY INDICATORS OF STORAGE BATTERY - PULSE CONVERTER - DC MOTOR SYSTEM  
OF BATTERY-DRIVEN VEHICLE IN REGENERATIVE BRAKING MODE

Kiev TEKHNIЧЕСКАЯ ELEKTRODINAMIKA in Russian No 5, Sep-Oct 84  
(manuscript received 11 Mar 84) pp 30-37

SHIDLOVSKIY, A. K., SKIDANOV, V. M., DENISENKO, A. V. and  
LITVINENKO, V. N.

[Abstract] Regenerative braking of battery-powered vehicles was investigated in order to determine the influence of changes in the converter control

parameters on the efficiency of individual components and of the battery - pulse converter - dc motor system as a whole. Expressions are derived for these efficiencies as a function of the basic control parameters for minimum numbers of variables. A formula is presented for the overall efficiency of the system. Recommendations are given for improving the efficiency of a number of systems, including the use of a capacitive filter in the storage battery circuit, switching the converter at low frequencies to regenerate power in the storage batteries, and avoiding the development of high currents in the battery - converter - motor system. References 8 Russian.  
[152-6900]

CIRCUITS AND SYSTEMS

UDC 621.314.228:029.6.001.24

FILTRATION OF INTERFERENCE PULSES FROM SUPPLY CIRCUITS OF RADIO ELECTRONIC EQUIPMENT

Moscow RADIOTEKHNIKA in Russian No 12, Dec 84  
(manuscript received 15 Dec 83) pp 78-79

RUSIN, Yu. S.

[Abstract] A filter for suppressing interference pulses in power supply circuits of radio electronic equipment is designed, assuming that switching and faults in the primary a.c. power network produce rectangular interference pulses of high amplitude and short duration. The filter is required to pass clearly all current harmonics from a 50 Hz or 400 Hz network. The filter is, therefore, a low-pass one with the upper cutoff frequency determined by the energy-effective width of the interference spectrum so that only a small fraction of the interference energy will pass through it. This design is a conservative one, inasmuch as spectrum of rectangular pulses is wider than that of any other pulses of the same amplitude and duration. It is feasible to use power transformers for filtering out interference pulses, but their leakage inductance  $L_s$  and stray capacitance  $C_o$  must satisfy not only the condition that

$\sqrt{L_s C_o} = R$  ( $R$ - load resistance) but also the condition that

$$\sqrt{L_s C_o} = \frac{2\tau h}{\pi h_0} \quad (\tau - \text{pulse duration, } h - \text{pulse amplitude, } h_0/h - \text{interference}$$

suppression ratio). References 3 Russian.  
[182-2415]

UDC 621.372.542.001.24

ZEROES AND POLES OF INPUT IMPEDANCE OF ELECTROMECHANICAL FILTERS

Moscow RADIOTEKHNIKA in Russian No 12, Dec 84 pp 79-80

[Annotation of article No 396 deposited at Central Scientific and Technical Institute 'Informsvyaz', 36 pp with 2 figures and 2 bibliographic references]

MALUGIN, V. P. and SAMOYLOV, V. S.

[Abstract] An algorithm is constructed for calculating the zeroes and the poles of the input impedance of electromechanical filters. Using the wave model rather than the equivalent circuit with lumped parameters yields more accurate experimentally verifiable results, especially in the case of wide-band filters. The algorithm is constructed for computer calculation by the conventional A-matrix method and is applied, for illustration, to a filter consisting of  $n$   $\Pi$ -sections with LC-parallel resonators in the shunting branches. The results obtained by this calculation can be used for tuning a filter section-by-section.

[182-2415]

UDC: 621.372.5

MATCHED FILTER FOR LFM SIGNAL

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 27, No 11, Nov 84 (manuscript received 9 Apr 84) pp 43-47

CHEKH, A. V.

[Abstract] The construction of matched filters based on a set of orthogonal filters consisting of decoupled single resonant tuned circuits is investigated. An analytical method is presented for determining the amplitude-frequency characteristic and gain delay. A breadboard matched filter is used for processing an LFM signal with duration of 75 msec and deviation of 140 Hz consisting of fifteen LC single resonant tuned circuits. The compression coefficient of the LFM signal agrees with the calculated figures, and the amplitude of the temporal distortions is no more than 10% when the weight coefficients are set to within  $\pm 5\%$ . References 6 Russian.

[146-6900]

UDC: 621.396.078

COMBINED CYCLES IN PHASE-LOCKED LOOP SYSTEM INCORPORATING HARMONIC FREQUENCY DIVIDER

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 27, No 11, Nov 84 (manuscript received 17 May 84 after revision) pp 87-89

FEDOSOVA, T. S. and AVER'YANOV, Yu. V.

[Abstract] The changes in the phase portraits of a phase-locked loop circuit as the parameters change are analyzed. The causes for the occurrence of the combined cycle are established, and a machine algorithm is developed for calculating the detuning values for which the combined cycle occurs. The occurrence of a combined cycle can disrupt synchronization in a frequency synthesizer employing a phase-locked loop with a harmonic frequency divider; the region of the combined cycle for such a phase-locked loop on the  $A, \gamma$  detuning plane is found to become smaller as the division factor of the frequency divider increases. References 3 Russian.  
[146-6900]

UDC: 621.314.572

QUASIHARMONIC SYNTHESIS OF SIGNALS WITH LIMITED LINE SPECTRUM

Kiev TEKHNIЧЕСКАЯ ЭЛЕКТРОДИНАМИКА in Russian No 5, Sep-Oct 84  
(manuscript received 21 May 84) pp 41-46

DMITRIKOV, V. F., PAVLOVSKIY, Ye. G. and TITOV, V. V.

[Abstract] A signal generator capable of producing signals with limited line spectra, specifically signals with assigned amplitude- and phase-frequency characteristics, is developed. The device is based on an approximation-type functional generator consisting of a step approximator and series with a low-pass filter. By limiting the infinite spectrum of the signal, the low-pass filter actually converts the approximating function from the N-dimensional space of piecewise constant functions to the M-dimensional space of trigonometric functions. An optimal quasiharmonic synthesis method is proposed which reproduces signals of the required type with zero methodical error. References 5 Russian.  
[152-6900]

QUANTUM ELECTRONICS, ELECTRO-OPTICS

UDC 537.533.3

DESIGN OF ELECTRON-OPTICAL DEVICES WITH GAS IONIZATION

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 29, No 12, Dec 84  
(manuscript received 7 Jun 83) pp 2442-2448

LONDER, Ya. I., SIBIRYAK, I. O., UL'YANOV, K. N. and TSKHAY, A. B.

[Abstract] A mathematical synthesis of axisymmetric gas-filled electron-optical devices is shown, a major advantage of such devices over vacuum devices being their higher perveance. Calculations involve solution of the internal (design) problem and the external (performance) problem. The former is assumed to be a one-dimensional one with rectilinear trajectories of charged particles. The latter is formulated in the paraxial approximation, first disregarding the presence of a plasma and then taking the plasma into account. When the plasma is included, its boundary becomes the virtual anode. For a determination of the electric field and potential distributions, the corresponding Poisson integro-differential equation is solved for the appropriate boundary conditions. A solution has been obtained by Taylor series expansions of the potential on the space-time grid and numerical evaluation of its integral, with second-order precision. Typical field patterns and numerical data are shown for high-perveance devices with an accelerating voltage not higher than 2000 V. Figures 4; tables 2; references 12: 9 Russian, 3 Western.  
[164-2415]

UDC 537.52:621.373.826

EXCITATION OF STREAKS IN HELIUM-NEON PLASMA

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 29, No 12, Dec 84  
(manuscript received 13 Apr 83) pp 2399-2402

ZAKHAROV, M. A., MOLCHANOV, M. I. and YAROSHENKO, N. G.

[Abstract] Earlier studies have established that ionization waves in glow discharge of noble gases form streaks and that the positive column constitutes

a self-oscillatory system with distributed feedback. Excitation of such streaks and attendant transient processes are important factors to consider in modulating the discharge current for laser experiments. An experimental study was therefore made of streaks in a d.c. discharge of a helium-neon mixture, for the purpose of determining their buildup time and decay time. A test tube 2 mm in diameter and 200 mm long was filled with a He:Ne=8:1 mixture under a pressure of 2.2 mm Hg, whereupon streaks were excited in it only with currents below  $I_1 = 2.3$  mA and above  $I_2 = 4.5$  mA. In the upper range of streak existence the oscillation frequency varied jumpwise from 1000 to 700 kHz as the current was varied from 4.5 to 8 mA, indicating a multimodal excitation of streaks with approximately 100 kHz frequency separations. Measurements were made and oscillograms were recorded with modulation of the discharge current by meander pulses of an amplitude  $\Delta I = I_H - I_L$  ( $I_1 < I_L < I_2$ ,  $I_H > I_2$ ) at a repetition rate of 1 kHz. The oscillation amplitude as function of time was measured on oscillograms of streaks and spontaneous lateral radiation, whereupon the length of the transient buildup and decay periods could be estimated roughly within a 50% error only. Oscillations were found to be delayed by 8  $\mu$ s and then have a period of 1-1.4  $\mu$ s, the buildup time varying over the 250-25  $\mu$ s range and the decay time varying over the 60-1  $\mu$ s range as the current was varied from 5.25 to 8 mA. The beats, with a period of 100  $\mu$ s or shorter at a higher current, decayed after 100-200  $\mu$ s. According to these data, streaks become steady within 200-250  $\mu$ s after excitation. Figures 2; tables 1; references 4 Russian.  
[164-2415]

UDC: 621.378

#### DESIGN OF OPTICAL SYSTEM FOR DOPPLER LASER ANEMOMETER - PART ONE

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE  
in Russian 1984 Vol 27, No 11, Nov 84 (manuscript received 29 Dec 82)  
pp 64-70

RINKEVICHYUS, B. S. and TIMOFEYEV, A. S., Moscow Power Engineering  
Institute

[Abstract] The study investigated the calculation of the parameters of the optical system of a Doppler laser anemometer with assigned measurement locality and accuracy. A method is described for designing sounding optical systems with an arbitrary set of components on the basis of a Gaussian model of the laser beam. The transformation of the Gaussian beam in the optical system as described in this section of the study makes it possible to analyze the influence of different parameters of the sounding optics on the characteristics of the interference field in the measurement space of the anemometer. The method presented for solving the inverse problems and the analytical formulas can be used to define the area of applicability of single-lens sounding systems for obtaining the required anemometer parameters. References 7 Russian.  
[156-6900]

UDC: 531.71:621.397

#### IMPROVING ACCURACY OF POSITION-SENSITIVE CCD SENSOR

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE  
in Russian 1984 Vol 27, No 11, Nov 84 (manuscript received 4 Jan 84) pp 70-77

ANDREYEV, A. L., NUZHIN, A. V. and PANKOV, E. D., Leningrad Institute of  
Precision Mechanics and Optics

[Abstract] An algorithm is presented that implements space integration of signals taken from a multielement charge-coupled device matrix in a optoelectronic sensor to enhance positional sensitivity. A device based on the algorithm is described and tested. The method described for measuring the coordinates of the axis of symmetry of the image, which entails averaging over the entire area of the illuminated region of a large number of elements, is found to have a number of advantages over other interpolation methods: the static characteristic is independent of the power of the radiant flux, the signal processing algorithm is fairly simple and easy to implement, and the method makes it possible in principle to achieve better measurement accuracy by using spatial signal integration. References 5: 4 Russian, 1 Western.  
[156-6900]

UDC: 635.853.22

#### ANALYSIS OF STATISTICAL ERRORS OF SPECTROMETER INPUT SIGNAL PROCESSING DEVICES

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE  
in Russian 1984 Vol 27, No 11, Nov 84 (manuscript received 28 Feb 83)  
pp 77-83

VERMAN, B. S., VLADIMIROV, Ye. N., and PRYANISHNIKOV, V. A.

[Abstract] This study examines the influence of the basic parameters of the input signal processing device in an X-ray spectrometer on the measurement error. Formulas needed for controlling the parameters automatically are derived and analyzed. The input signal processing device examined incorporates a pulse amplifier, an amplitude selector-discriminator, additional discriminators and a controller. The operation of the spectrometer is explained. The static and equipment errors are analyzed. Formulas for the error signal show that the relationship between that signal and the relative variation in gain is practically the same for  $\epsilon = 0, 0.1$  and  $0.2$ .  
References 3 Russian.  
[156-6900]

UDC: 535.317.2

POWER AND COMPENSATING CAPABILITIES OF SCHEMATIC DIAGRAM OF RUSSAR-29 LENS

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE  
in Russian 1984 Vol 27, No 11, Nov 84 pp 83-88

YES'KOVA, L. M., Leningrad Institute of Precision Mechanics and Optics

[Abstract] Two modifications of the Russar-29 lens were considered: one with a diaphragm in the glass, and one with the diaphragm in the air space between two flat surfaces. Both versions were investigated for angular field development, reduced overall dimensions, astigmatism, image curvature and distortion compensation as a function of the variation in the index of refraction of the glass and curvature of the base lens. The relative distortion and longitudinal aberration at the edge of the field in the pupils in the back half of each version are tabulated. A system with a low index of refraction ( $n \approx 1.5$ ) and with curvature of  $\alpha_2 = -5.0$  of the negative air lens is recommended. References 2 Russian.

[156-6900]

UDC: 621.383.087.92

USE OF TWO-PHASE RASTER SECTION IN OPTOELECTRONIC DISPLACEMENT TRANSDUCERS EMPLOYING PHASE RASTER INTERPOLATORS

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE  
in Russian 1984 Vol 27, No 11, Nov 84 (manuscript received 10 Aug 83)  
pp 88-91

SHILIN, V. A., Moscow Institute of Geodetic, Aerial Photography and Cartographic Engineers

[Abstract] The circuit of the generating part of the phase raster interpolator employed in an optoelectronic displacement transducer, which requires a two-phase system of signals (a two-phase raster section), is examined. The schematic diagram of the generating section of the interpolator is presented and traced. The use of such a phase interpolator in a VE-51 circular displacement transducer is described. References 2 Russian.

[156-6900]

UDC: 772.99(088.8)

NEW MEDIA FOR OPTICAL RECORDING OF INFORMATION

Kiev DOKLADY AKADEMII NAUK UKRAINSKOY SSR, SERIYA A: FIZIKO-MATEMATICHESKIYE I TEKHNIЧЕСKIYE NAUKI in Russian No 12, Dec 84  
(manuscript received 24 Nov 83) pp 55-58

KOLEZHUK, K. V., SAVCHUK, A. V., SAL'KOVA, Ye. N. and SOSKIN, M. S.,  
Institute of Physics, Ukrainian SSR Academy of Sciences, Institute of  
Semiconductors, Ukrainian SSR Academy of Sciences

[Abstract] New recording media suitable for holographic recording of information in the red and infrared regions of the spectrum were investigated. Holographic recordings were made by means of a ruby laser ( $\lambda = 0.69 \mu\text{m}$ ) and a Yag:Nd<sup>3+</sup> laser ( $\lambda_2 = 1.06 \mu\text{m}$ ) on CdTe and Cd<sub>20</sub>Hg<sub>80</sub>Te films, both of which turned out to be suitable for holographic recording. The recording mechanism was investigated by electron-microscope and X-ray microanalysis, as well as secondary-ion mass spectrometry. It was found that the micro-parameters and mechanisms underlying holographic recording can be determined only by using spectral, structural and other methods in combination.

References 4: 2 Russian, 2 Western.

[153-6900]

INDUSTRIAL ELECTRONICS AND CONTROL INSTRUMENTATION

UDC: 621.372.2

METHOD FOR ANALYZING FREQUENCY RESPONSES OF MULTILAYER ELECTROTHERMAL  
TRANSDUCERS

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVFEDENIY: RADIOELEKTRONIKA in Russian  
Vol 27, No 11, Nov 84 (manuscript received 7 May 84 after revision) pp 91-93

BOKRINSKAYA, A. A. and BOGDANOV, S. G.

[Abstract] An analytical method is developed that makes it easy to obtain the frequency responses of multilayer electrothermal transducers for an arbitrary number of layers of the working body and for arbitrary heat exchange conditions. Formulas are derived for the conversion coefficient determining the frequency responses of a multilayer electrothermal transducer. In calculating the frequency responses, the conversion coefficient is multiplied by the conversion coefficient of the input electrical signal and the conversion coefficient of the output electrical signal. References 3 Russian.  
[146-6900]

UDC: 62-52

INNER METHOD FOR ANALYZING STABILITY OF PERIODIC PROCESSES IN DIGITAL  
AUTOMATIC SYSTEMS

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE  
in Russian Vol 27, No 10, Oct 84 (manuscript received 18 Nov 83) pp 14-17

KOLESNIKOV, N. K.

[Abstract] An inner approach to determining the region of localization of the roots of polynomials with complex coefficients is proposed for investigating the stability of intrinsic periodic processes in digital automatic systems. A necessary and sufficient condition for all of the roots of an equation with complex coefficients to lie within the unit circle is that the matrix formed from the coefficients of the polynomial in question be an inner-positive matrix. The periodic process in the digital automatic system will thus be stable if said matrix is inner-positive. The stability of the

intrinsic periodic process occurring in a digital automatic system in which the transfer function of the reduced linear pulse part of the system has a specified form is investigated as an example. The inner approach is found to be an effective method for computer analysis of the stability of periodic processes in digital automatic systems. References 5 Russian.  
[186-6900]

UDC: 681.3

#### DEVICE FOR COMPUTING MODULUS OF VECTOR FROM TWO ORTHOGONAL COMPONENTS

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE  
in Russian Vol 27, No 10, Oct 84 (manuscript received 21 Sep 83) pp 27-31

KOVALEV, A. M., PUCHKOV, Yu. I. and PERELYAYEV, V. Ye., Smolensk Branch,  
Moscow Power Engineering Institute

[Abstract] A device is described for computing the vector modulus from two orthogonal components by the direct method in which the same blocks are used to perform the inverse operations of squaring and extracting the square root. Conditions are found for obtaining the maximum speed in processing mismatches with opposite signs. Basic relationships are derived for the slope of the integrators. Experimental results are cited that confirm the validity of the theoretical conclusions regarding the potential capabilities of the proposed structures in terms of accuracy and speed. References 5 Russian.  
[186-6900]

UDC: 621.317.761

#### HIGH SPEED FREQUENCY-CODE CONVERTER

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE  
in Russian 1984 Vol 27, No 11, Nov 84 (manuscript received 28 Mar 84)  
pp 44-48

[Abstract] A device was examined that combines the functions of an absolute frequency value-to-code converter and a relative frequency deviation-to-code converter. The operating speed of the device was investigated, and the error of the digital part analyzed. The device consists of a pulse generator, a reference frequency generator, three binary frequency multipliers, pulse counters, a control counter, a nominal period counter, a period comparison circuit and a result counter. The measurement time for the absolute frequency value, or for the relative frequency deviation, is equal to one period of the input signal. The total error of the digital section of the converter comprises the quantization error in measuring the period and the error due to imperfection of the binary frequency multipliers. The error of  $\pm 0.5\%$  found analytically agrees with the findings of experiments on a real prototype.  
[156-6900]

UDC: 681.335

#### DIGITAL FREQUENCY CONVERTER

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE  
in Russian 1984 Vol 27, No 11, Nov 84 (manuscript received 24 Oct 83)  
pp 48-52

IVANOV, V. A.

[Abstract] A fractional digital frequency converter with predictable error is proposed in which the initial data are represented by numbers having a variable base in the fractional part. The device employs a recursive algorithm derived elsewhere that is modified by the authors. The structural diagram of the converter is presented and explained. The limit to which the error can be reduced by increasing the fundamental frequency is determined by the speed of the digital pulse frequency divider; the other blocks of the circuit are timed by low-frequency input pulses, and therefore do not have to operate fast. References 6 Russian.

[156-6900]

UDC: 62-52

#### SPECTRAL-TEMPORAL METHOD FOR STATISTICAL IDENTIFICATION OF OBJECTS WITH VARIABLE PARAMETERS

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE  
in Russian 1984 Vol 27, No 11, Nov 84 (manuscript received 21 Feb 84)  
pp 14-19

DMITRIYEV, A. N. and YEGUPOV, N. D., Kaluga Branch, Moscow Higher Technical School imeni N. E. Bauman

[Abstract] A method is examined for identifying linear objects with variable parameters. Identification is defined as the construction of a mathematical model in an assigned class of objects from experimental data. Three equivalent forms for describing objects of identification by equations with differential, integral and matrix operators are analyzed. An algorithm employing spectral representation of the functions in orthogonal bases is derived. The synthesis of compensating devices is examined as an example of the application of the method. References 9 Russian.

[156-6900]

UDC: 62-58.001

ANALYTICAL SYNTHESIS OF AUTONOMOUS MULTIDIMENSIONAL SYSTEMS

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE  
in Russian 1984 Vol 27, No 11, Nov 84 (manuscript received 4 May 84)  
pp 30-34

GAYDUK, A. R., Taganrog Electrical Engineering Institute imeni V. D. Kalmykov

[Abstract] The synthesis of an autonomous multidimensional automatic control system is examined on the basis of state and input control, which makes it possible to investigate the existence of a solution of the problem, and to find analytically the structure and parameters of the controller (if a solution exists). The equations describing the controller are sought in input-output form, and the realization is based on equations in the state space. A numerical example is presented to illustrate the selection of the poles and the analytical method for synthesizing autonomous multidimensional automatic control systems. References 6 Russian.  
[156-6900]

INSTRUMENTATION AND MEASUREMENTS

UDC 621.317.727.1.024-758.001.24

DESIGN OF SHIELDS FOR 1000 kV D.C. VOLTAGE DIVIDER

Moscow ELEKTRICHESTVO in Russian No 10, Oct 84  
(manuscript received 20 Jul 83) pp 67-69

KOZHOKARU, D. I. and SHMELEV, G. M., Kishinev

[Abstract] An optimum electrostatic top shield is designed for a 1000 kV d.c. voltage divider, a vertical column with a stack of uniformly spaced tight shielding rings, to ensure maximum accuracy and reliability of measurements made with such a device. The design is based on maximum permissible electric field intensity at the shield surface of minimum possible area, below the corona-breakdown level. Shields for this application are made of manganin microwire with glass insulation. A twin toroidal shield configuration has been selected on the basis of the empirical relation for the corona-breakdown electric field intensity

$$E_0 = 24.5\delta_a \left(1 + \frac{0.613}{(1/2\delta_a d)^{0.4}}\right) \text{ kV/cm } (\delta_a - \text{relative}$$

density of air,  $\delta_a = 1$  at 25°C and 760 mm Hg,  $d < 40$  cm diameter of circular conductor cross section,  $D \geq 7d$  median diameter of torous). The optimum torus diameter has been found to be  $D = 1.55$  m, with  $d = 0.25$  m and height of the upper torus above ground  $h = 1$  m for a 25% margin of electric strength. The maximum normal component of electric field intensity at the surfaces of both upper and lower tori is calculated, this component acting at an angle to the radial coordinate in the plane of each torus and thus also at an angle to the common axis of both tori. This angle characterizes the nonuniform charge and field distribution over the surface, owing to the ground proximity effect and presence of charged rings. Calculations are based on Fourier series expansion for an oblate spheroid. The maximum normal electric field intensity, proportional to the charge on a given torus and to a special function of the action angle, is referred to the maximum corona-breakdown field intensity (typically 27.8 kV/cm). Figures 1; tables 1; references 11: 9 Russian, 2 Western.  
[150-2415]

UDC: 621.391

ESTIMATION OF DURATION OF RANDOM GAUSSIAN SIGNAL

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE  
in Russian 1984 Vol 27, No 11, Nov 84 (manuscript received 19 Mar 84)  
pp 9-13

TRIFONOV, A. P., GALUN, S. A. and PARFENOV, V. I., Voronezh State  
University imeni Lenin Komsomol

[Abstract] The hardware implementation of a maximum-likelihood device for measuring the duration of a random Gaussian signal was investigated. A quasioptimal device incorporating a filter with transient response  $h(t)$ , a squarer and a decision device that registers the position of the absolute maximum of the signal at the integrator output, which serves as the estimate, was synthesized. Expressions whose accuracy increases as the duration of the signal and its equivalent bandwidth are derived for the bias and variance of the estimate. References 3 Russian.  
[156-6900]

MAGNETICS

UDC 621.335.625.2.012.858:538.65

DESIGN OF MAGNETIC CIRCUIT COMPONENTS FOR MAGNETIC SUSPENSION SYSTEMS

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA  
in Russian No 12, Dec 84 (manuscript received 20 Dec 82) pp 102-103

FRISHMAN, YEVGENIY MOISEYEVICH, candidate of technical sciences, docent,  
Dnepropetrovsk Institute of Railroad Transportation Engineers,  
ALEKSANDROV, ADOL'F MORITSEVICH, engineer, and ISKANDEROV, ALEKSANDR AZIZOVICH,  
engineer

[Abstract] A magnetic suspension for a vehicle is considered which utilizes the repulsion forces between permanent magnets. The vehicle rides along an aisle between two linear arrays of identical magnets with rectangular cross sections, one array above the other and each mounted on a continuous straight yoke of ferromagnetic material on the back side. The polarity of magnets in each array alternates, the polarity of magnets facing each other across the aisle is the same. Use of ferromagnetic yokes increases the vertical suspension force by contributing to a higher concentration of magnetic flux in the working air gaps between vehicle and magnets. The problem of optimally designing these yokes for maximum suspension force with minimum mass of material is solved by determining the yoke thickness which corresponds to magnetic saturation. Calculations are based on the method of mirror images, assuming an infinite magnetic permeability of the yoke material and a unit length of the vehicle. The magnetic flux in each successive loop of two neighboring magnets in one array, the yoke behind them, and the vehicle is determined according to the fundamental laws of magnetostatics for the given configuration. The width of the return path should theoretically be infinite, but making it practically equal to 1.5 times the pole pitch results in an error not larger than 2%. Graphs of yoke thickness as function of pole height for various yoke width demonstrate this. Figures 3; references 1 Russian.

[181-2415]

UDC: 621.313

#### FORCE CHARACTERISTICS OF ACTIVE MAGNETIC SUSPENSION

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE  
in Russian Vol 27, No 10, Oct 84 (manuscript received 21 Nov 83) pp 57-63

LYSENKO, A. P., OBRAZTSOV, A. N. and TORAMANYAN, O. S., Leningrad  
Mechanical Institute

[Abstract] Expressions are derived for the centrifugal forces of an active magnetic suspension that allow for the magnetic resistance of the steel parts of the magnetic conductor. A suspension is described in which the electro-mechanical section consists of two electromagnetic supports, each with a four-pole stator with windings on its poles, and a conical rotor. The rotors are connected by a shaft to which the suspended body is secured. When the rotors of the device move away from their central position, an amplifying and converting device changes the currents in the windings so that the resulting force returns the moving section to the central position. The formulas obtained indicate that the magnetic resistance of the steel parts of the magnetic conductor have a strong influence on the force characteristics of the suspension, and allow these characteristics to be calculated. Formulas are derived that can be used to select the regulation principle that provide the required force characteristic with the assigned pick-up force.

References 4 Russian.

[186-6900]

UDC: 538:681.32; 681.84.083.82

#### CHARACTERISTICS OF MAGNETORESISTIVE CONVERTERS

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE  
in Russian 1984 Vol 27, No 11, Nov 84 (manuscript received 4 May 84)  
pp 57-63

KARPENKOV, S. Kh., Moscow National Economic Institute  
imeni G. V. Plekhanov

[Abstract] The output signal of a magnetoresistive element employed for magnetic recording playback is analyzed with allowance for the plan Hall effect and the plane thermomagnetic effect. The playback signal produced by a magnetoresistive element is found to include the potential difference caused by the magnetoresistive effect as well as parasitic potential differences. The parasitic signals are estimated quantitatively, showing that the contribution of the thermomagnetic component is less than the Hall effect component in magnetoresistive elements with high iron content. Ways of reducing the parasitic thermomagnetic and Hall components are described.

References 12: 4 Russian, 8 Western.

[156-6900]

SOLID STATE CIRCUITS

CHANGE IN EFFECTIVE MASS AND MOBILITY OF ELECTRONS DURING MELTING OF  
GERMANIUM AND SILICON

Leningrad FIZIKA I TEKHNIKA POLUPROVODNIKOV in Russian Vol 18, No 10, Oct 84  
(manuscript received 3 Apr 84, signed to press 22 May 84) pp 1846-1851

GLAZOV, V. M. and KOL'TSOV, V. B., Moscow Institute of Electronic  
Engineering

[Abstract] Phase transition of germanium and silicon from crystal to melt is regarded as a melting process of the semiconductor-metal kind. Attendant breakdown of  $sp^3$ -hybrid homeopolar bonds and consequently increasing concentration of free electrons are considered for estimation of changes in the electron mobility, the latter depending on the effective mass of conduction electrons and in turn determining the electrical conductivity. The electronic component of entropy change, needed for this estimation, is calculated independently in three different ways: 1) from the jump of thermal emf; 2) from the difference between total entropy change and the sum of its two, vibrational and positional, components; 3) according to the classical Boltzmann thermodynamic statistics. The results obtained by all three methods are of the same order of magnitude and indicate an appreciable increase of the effective electron mass. The temperature dependence of electron mobility within the range of crystal - melt phase transition for germanium and silicon can be reliably established on this basis, with use of relevant theoretical and experimental data. Melting decreases the electron mobility, accordingly, to 1/745th in germanium and to 1/50th in silicon. These estimates correlate with the estimated changes in effective mass of conduction electrons in the two substances as a result of melting. Figures 1; tables 1; references 16: 15 Russian, 1 Western (in Russian translation).  
[117-2415]

SPATIAL LOCALIZATION OF RADIATION-STIMULATED GETTER ACTION

Leningrad FIZIKA I TEKHNIKA POLUPROVODNIKOV in Russian Vol 18, No 10,  
Oct 84 (manuscript received 1 Nov 83, signed to press 18 May 84)  
pp 1885-1887

BORKOVSKAYA, O. Yu., DMITRUK, N. I., KONAKOVA, R. V. and LITOVCHENKO, V. G.,  
Institute of Semiconductors, UkSSR Academy of Sciences, Kiev

[Abstract] Already small doses of  $\gamma$ -radiation or fast electrons have been found to produce "internal getter action of dislocations and precipitates on recombinationally active impurities in  $Al^{III}B^V$  semiconductors, this action resulting in a longer lifetime of minority charge carriers near an interface. For the purpose of establishing and evaluating the dependence of this effect on the recombination parameters and on the level of interface defectiveness, an experimental study was made using GaAs single crystals in the form of both cast bars and 15  $\mu m$  thick epitaxial  $n-n^+$  films for special Schottky barrier diodes. With tin used as contact material, these Schottky barrier diodes with a nearly ideal forward branch of the current-voltage characteristic could be produced by a cold process. The diodes were exposed to weakly absorbable radiation within the self-absorption band ( $\lambda = 0.88 \mu m$ ). The diffusion length for minority charge carriers was then determined from the dependence of the short-circuit photocurrent on the inverse of capacitance. The results indicate that both free and metallized surfaces of irradiated GaAs constitute effective drains for point defects, which under normal conditions reduce the recombination rate at the surface as well as in the bulk. Annihilation of defects, on the other hand, causes a preferential lengthening of the diffusion path within the subsurface region. Figures 1; references 8: 5 Russian, 3 Western.  
[117-2415]

UDC: 621.397.331

SCANNING OPTOELECTRONIC SYSTEMS FOR IMAGE PROCESSING EMPLOYING SERIAL-PARALLEL PROCESSOR

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE  
in Russian Vol 27, No 10, Oct 84 (manuscript received 21 Feb 83) pp 69-77

GORELIK, S. L., Leningrad Institute of Precision Mechanics and Optics

[Abstract] A new class of optoelectronic image processing systems is examined whose technical implementation principles make commercial production possible given the current component base. The devices in question are hybrid optoelectronic systems that employ light apertures with variable form, dimension and brightness that scan the image field. Algorithms are presented for extracting contour elements with a given orientation by means of anisotropic filtering, for filtering fine-structure interference, for correcting

visual sharpness and for optimal filtering of contours on images by locally adaptive anisotropic filtering. Electrooptically controlled scanning optoelectronic processors are found to be highly promising for the development of hybrid processors for image processing systems; serial-parallel processors can be employed for photographic image processing, as well as for processing images of real scenes with the help of television cameras. References 8 Russian. [186-6900]

UDC: 535.317.2

ANALYSIS OF ERRORS OF OPTOELECTRONIC SCANNING SYSTEM FOR MEASURING  
COORDINATES OF MOVING RADIATOR

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE  
in Russian Vol 27, No 10, Oct 84 (manuscript received 2 Jan 83) pp 77-81

SHIRABAKINA, T. A., Moscow Institute of Geodetic, Aerial Photography  
and Cartographic Engineers

[Abstract] An optoelectronic scanning system for measuring the coordinates of a moving radiator is examined. The field of view is analyzed by rectilinear scanning using a linear multielement photodetector. Errors caused by spread of the parameters of the multielement photodetector and instability of the scanning rate are analyzed. Formulas and graphs are presented that can be used to calculate the coordinate measurement error as a function of the dimensions of the element and inaccuracy in its fabrication, as well as the error introduced by spread in the sensitivity of the photodetector. References 4 Russian. [186-6900]

UDC: 681.3.05

OBTAINING INFORMATION ON DIRECTION OF DISPLACEMENT FROM PULSE SHAPE OF  
ANGULAR DISPLACEMENT PHOTSENSORS

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE  
in Russian Vol 27, No 10, Oct 84 (manuscript received 9 Jan 84) pp 85-87

GORODETSKIY, A. Ye., KUZ'MIN, P. P., LYASHENKO, N. N. and PANKOV, E. D.,  
Leningrad Institute of Precision Mechanics and Optics

[Abstract] This study explains the use of the form of the electrical pulses output by the photodetector in shaft angle sensors in order to enhance their information capacity. A moire angular displacement sensor is described in which the output electrical signal of the second photodetector depends upon the amount and direction of the displacement of the object being investigated. It is shown that more information can be derived from the photosensors by making the output pulses asymmetrical.

The instrumental component of the errors of the sensor is reduced by employing, e.g., circular or triangular holes in the masks. By making the shapes of the edges of the openings in the masks variable, it is possible to adjust the slope of the sensor characteristic and to increase their information capacity. References 4 Russian.

[186-6900]

UDC: 621.397.13:621.96:621.385.832.522

DISSECTOR SYSTEMS FOR SEEKING OPTICAL RADIATION WITH INTENSITY-MODULATED  
SUBCARRIER FREQUENCY

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE  
in Russian Vol 27, No 10, Oct 84 (manuscript received 12 Dec 83) pp 81-85

BICHKOV, S. I., RUMYANTSEV, K. Ye. and FIRSOV, V. S., Leningrad Electrical  
Engineering Institute imeni V. I. Ul'yanov (Lenin)

[Abstract] A method is presented for calculating the basic parameters of an analog dissector system employing spatial search for optical radiation with intensity-modulated subcarrier frequency. Quantitative relationships are established between the energy and temporal parameters of the system, and are compared with the parameters of digital search equipment. An example of the calculation of the parameters of an analog dissector system is presented. It is found that the energy losses in digital search equipment can be minimized as compared with analog equipment by producing receiving optics with smaller aberrations. References 5 Russian.

[186-6900]

COMPUTERS

UDC: 621.317.4-52

MICROPROCESSOR ANGULAR MEASUREMENT CORRECTOR

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 27, No 11, Nov 84 (manuscript received 3 Jan 84) pp 51-55

GOLYAS, Yu. Ye., SEVRYUKOV, B. N. and TIKHONOV, V. A.

[Abstract] A microprocessor corrector is described that compensates the systematic error component of a standard shaft angle encoder. The software employs first-degree splines to find the best uniform approximation. The structural diagram of the angular positional correction block is presented and traced. It is found that the use of this block in the angle measurement loop improves the sampling accuracy by a factor of 2.5 when a standard angular coordinate measuring device is used. In addition to reducing sampling errors in high precision shaft angle encoders, the compensation approach also improves the accuracy of medium-precision digital measuring devices in which the main error component is systematic. References 2 Russian. [146-6900]

UDC: 681.322

SO-04 MICROPROCESSOR DEVELOPMENT AND DEBUGGING SYSTEM

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 27, No 11, Nov 84 (manuscript received 19 Jun 84 after revision)  
pp 109-111

SIGALOV, V. I.

[Abstract] An automated system for developing and debugging SO-04 microprocessor equipment is described. The SO-04 system is a resident system based on a KR580IK80 microprocessor employed in a UVS-01 microcomputer employing Simvol displays, a UVP-01 floppy disk drive, a DZM-180 dot-matrix printer, an FS-1501 paper tape reader, a PL-150 tape punch, a UP-01 PROM programmer and a UVE-01 emulator. Recommendations for the use of the system in developing and debugging the hardware and software components of

technical devices based on the K580-series microprocessor are presented. Experience with the SO-04 system has proven it to be an effective means for automating microprocessor development and debugging. References 4 Russian. [146-6900]

UDC: 681.325

#### ORGANIZATION OF INPUT OF CONSTANTS TO LSI LOGARITHM COMPUTERS

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE  
in Russian Vol 27, No 10, Oct 84 (manuscript received 10 Nov 83) pp 32-36

BAYKOV, V. D. and KRY'S', A. I., Leningrad Electrical Engineering Institute  
Imeni V. I. Ul'yanov (Lenin)

[Abstract] A method is proposed for generating constants for calculating logarithms and antilogarithms iteratively 'digit-by-digit', making it possible to employ uniform matrix computer cells. The organization of the parallel input of constants of the type  $C_1 = \log_b(1 \pm 2^{-1})$  is examined using a logarithm computer as an example. Similar recursive relationships are used to compute the antilogs. A method is examined for generating constants that makes it possible to cut the number of memory locations in half, as well as to halve the number of ROM accesses and the required number of external unswitched logic matrix contacts. The proposed methods for generating constants also extend to other types of constants. References 3 Russian. [186-6900]

UDC: 681.335

#### PROBLEMS OF IMPROVING ACCURACY OF COMPUTER DEVICES EMPLOYING EXPONENTIAL SWEEP

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE  
in Russian Vol 27, No 10, Oct 84 (manuscript received 27 Jan 84) pp 37-42

BERESNEV, V. K. and ROZACHEVSKIY, B. M., Novosibirsk Electrical Engineering Institute

[Abstract] Methods are proposed for enhancing the accuracy of exponentially-swept computer devices by reducing the influence of the delay of the comparison devices and the instability of the time constant of the exponential sweep. A structural method is proposed for reducing the error due to comparison device delay in which the input voltage and output voltage are both converted to a time interval simultaneously and the signals produced by the two voltage-to-time interval converters are subtracted, with the resulting signal controlling the re-charging of the storage element in the analog

storage device, thus providing mutual compensation of comparison device delays. A multifunctional converter based on the proposed method is described. Devices capable of performing multiplication, division, raising to powers and extraction of roots to within approximately 0.05% are described and proven experimentally. References 4 Russian.  
[186-6900]

COMMUNICATIONS

UDC 656.254.16

RADIO COMMUNICATION SYSTEM 'TRANSPORT': DEVELOPMENT STAGES AND PROSPECTS FOR INTRODUCTION

Moscow AVTOMATIKA, TELEMEXHANIKA I SVYAZ' in Russian No 5, May 84 pp 4-6

[Article by Yu. V. Vavanov, first assistant of the chief designer of the system "Transport", chief of the radio communications laboratory of the All-Union Scientific Research Institute of Railroad Transportation, Candidate of Technical Sciences]

[Text] The Board of the Ministry of Communications examined the problem of the development and wide introduction in railroad transportation of the complex radio communication system "Transport" which is being developed by the enterprises and organization of the MPS [Ministry of Communications], the Ministry of the Communications Equipment Industry, Ministry of the Electronics Industry and the Ministry of the Electrical Equipment Industry in conformity with a unified coordination plan. The complex of devices includes stationary, transportable and portable radio stations for train, station and maintenance radio communications.

The board noted that, due to the use of modern achievements in the area of radio and electronic engineering and maximum consideration given to the purpose of each type of communication during the development of the system, the devices being developed have wide functional possibilities, are more reliable than the existing ones and their use will make it possible to introduce more sophisticated technologies and increase the efficiency of the operation of transportation facilities.

Plans were determined for wide introduction of the radio communication system "Transport" for the period to the year 1990, the order of putting new devices into service, replacement of outdated radio stations of train radio communication with two-band radio stations ZhR-UK and radio stations of the "Transport" system, first of all, in the communication direction of paired and heavy-weight trains. In the process of the introduction of new radio facilities, a goal was set to reexamine the technological processes of the operation of transportation subdivisions, ensuring the improvement of control and acceleration of production processes, increase in the productivity of labor, improvement of traffic safety, and improvement of the services to the passengers. It is planned to train radio communication engineers and technicians with consideration of a wide introduction of new radio facilities in railroad transportation.

Improvements of the operation procedures of the railroad transportation facilities and increased traffic volumes impose new requirements upon the system and means of railroad radio communications. The radio communication system must ensure: a high quality and reliability of radio communication under the conditions of high levels of interference pulses; increased number of channels on the basis of effective utilization of the electromagnetic spectrums; operation of a large number of radio facilities in one region without mutual interference; maximum conveniences in the use of radio equipment, ergonomics with consideration of the operation processes for various classes of workers; optimal methods of transmitting discrete information with a prescribed degree of reliability. It is necessary to create radio networks with equally accessible channels in order to improve the efficiency of their use, and to ensure the access of the subscriber of radio networks to the railroad automatic telephone communication network (ZhATS) and to ensure a high degree of reliability of the equipment and the automatized methods of its operation control. These requirements are satisfied by the "Transport" system being developed. It includes train, station and maintenance and operation radio communication.

Train radio communication (PRS) includes:

the control-room line radio communication within the limits of the section which, depending on its load intensity, can be duplex with individual calls to operators, or simplex with group calls;

radial radio communication with operators of train locomotives with persons ensuring safety of train movements connected with the train operation or with services to the passengers in different section of the road.

In the PRS system, train locomotives are equipped with a two-band transportable radio stations RV-1 which provide communication both with traffic controller, and with subscribers in various sections.

For the organization of the line duplex dispatcher radio communication in the decimeter band (330 MHz), stationary radio station RS-1 connected by a loop in a four-wire standard telephone channel with the control office SR-1 connected to it. Communication between the dispatcher and the engineer can be accomplished in the telephone mode or by transmitting commands and reports. Moreover, provisions are made for the mode of automatic data transmission.

The duplex system has provisions for the possibility of relaying signals along the line in the absence of a four-wire channel. For this purpose, there are two stationary RS-1 radio stations and one PRM-S stationary receiver.

In order to eliminate interfering effects of the radio facilities of neighboring dispatchers' zones, six groups of operating frequencies are used. Each group has six or four frequencies, respectively, for sections with relaying facilities or with the use of a four-wire channel. Frequencies are selected with consideration of eliminating the blocking of the channel or intermodulation interference. Automation of the switching of the frequency groups is accomplished with the aid of special low-power stationary transmitters ("radiobeacons") installed at the junctions of the zones. A signal from a "radiobeacon" received by the transportable radio station RV-1 acts upon the control circuit of the synthesizer and switches the frequency group.

The train simplex dispatcher's radio communication is constructed according to a linear principle in the range of the metric (151...156 MHz) or hectometric (2.13 MHz) waves on a single common operating frequency. All RS-6 stationary radio stations are connected to a common two-wire telephone cable to which the control office is also connected.

In the PRS system, in addition to linear dispatcher's radio communication, engineers can establish the connection with subscribers at various points of the section. Radio communication is carried out in the simplex mode on frequencies in the 151...156 MHz band with conference calls. For this purpose, station operators on duty have stationary RS-2 or portable RN-3 radio sets. Portable radio sets are used by operators on duty at crossings (RN-2), train guards, or guards at various facilities (RN-1). Depot attendants on duty are equipped with RS-2 radio station, maintenance foremen are equipped with transportable radio stations RV-5 or RV-6, and signalmen have portable RN-1. Transportable radio stations RV-2 are intended for crew leaders of passenger trains. For establishing radio communication, all these users are assigned operating frequencies which are divided into groups within the limits of dispatcher's sections. The selection of frequencies is done with consideration of eliminating blocking and intermodulation interference.

Station radio communication (SRS) includes:

- radio communication for shunting and use in mountainous areas;
- radio communication for the personnel engaged in making-up of trains;
- radio communication with equally accessible channels.

For organizing radio communication for shunting and use in mountainous areas, locomotives are equipped with transportable radio stations RV-3, while the shunting dispatcher and the depot on-duty personnel have stationary radio stations RS-3 with two or three control panels. The personnel engaged in the making-up of trains and their assistants are equipped with portable radio sets RN-12B, while brake shoe checkers, fitters and other workers -- portable receivers PRM-N.

These radio networks operate with conference calls or with an open channel. Radio communication of the personnel engaged in the making-up of trains includes radio networks of record keepers, maintenance inspection centers (PTO) and commercial inspection stations (PKO), brake operator, freight yard dispatcher, and container platform operator. These radio networks are organized with portable radio sets with which commanders (RN-3) and executors (RN-12B) are equipped.

All of the above radio networks operate in the 151...156 MHz frequency band; they are used most widely, and therefore, 72 six-frequency working groups are allotted for them.

In SRS, all calls are recorded at stationary radio stations by tape recorders.

Maintenance and operation radio communication (RORS) includes:

constantly operating dispatcher's linear radio communication;

temporary dispatcher's maintenance radio communication;

radio communication within the work area;

maintenance and operation service radio communication.

The organization of the dispatcher's linear radio communication is identical to the organization of this type of radio communication in the PRS system. Here, RS-6 radio stations and SR-34 control stations are used. However, due to the technological characteristics of various services, junctions of the dispatchers' zones may not coincide, and dispatchers could be located in different territorial regions. In this connection, provisions are made for using two CR-34 control stations and for their connection at any point of the line.

For the organization of temporary dispatcher's maintenance radio communication in a work area, an RS-4 stationary radio station is installed and is connected to a wire channel, and the dispatcher is given an SR-2 control station which can be up to 300 km away from the RS-4. The radio network operates in the simplex mode with conference calls. The RS-4 radio station is controlled through a wire channel by two-frequency code signals.

Radio communication within a work site is organized in the simplex mode with conference calls. The users are equipped with portable radio sets RN-12 or RN-4. The operable condition of the channel is monitored by sending periodic audio frequency signals and their monitoring at the reception point. In order to inform the workers about approaching trains, provisions are made for connecting a siren or using an UGO-1 loudspeaker.

The dispatcher and operation service radio communication is organized in the decimetric wave band (330 MHz) with the use of three-duplex and four-duplex equally accessible channels and individual calls of the users. Provisions are made in the radio network for connections from moving vehicles to the users of the railroad ATS and for calling moving users by the latter. The radio network includes stationary RS-7 equipment and transportable RV-8 radio stations. Radio communication will be organized in the semiduplex mode on the radial-linear principle. The structure of its organization allows to change it in the future into linear organization.

Thus, the "Transport" system is based on seven types of stationary (RS), seven types of transportable (RV), and four types of portable (RN) radio sets, a portable receiver, two types of stationary receivers, three types of control stations, as well as stationary transmitters ("radiobeacons") for switching the frequency groups of train locomotive radio stations. The "Transport" system also includes: auxiliary equipment including tunnel equipment (AT) for organizing radio communication in tunnels through guiding lines; a unified remote-control device UT-U for transmitting discrete information through simplex channels; a line distributor (RL) for the duplex system of train radio communication; a device for connecting two-wire and four-wire channels (US 2/4) for the simplex system of train radio communication; a container (K) for installing stationary

radio stations where there are no service buildings; loudspeaker systems of various power capacities (UGO-1 and UGO-2).

In developing this system, an important role is given to the measuring instruments system (KIS) which will make it possible to improve the effectiveness of service of the radio facilities. The system will include: a stand for measuring the parameters of radio stations in the conditions of checking and maintenance points KIS-KRP; equipment for automatic measurement of the parameters of transportable radio stations KIS-ASV directly under operating conditions, for example, during the exit of locomotives from the depots. The system will include also: equipment for automatic checking of stationary radio stations in the simplex KIS-ASS-S and in the duplex KISS-ASS-D systems of train radio communication under operating conditions; a control and testing stand for laboratory cars KIS-VL intended for automated measurement of the field intensity of stationary, transportable and portable radio sets and radio interference levels in the hectometric, metric and decimetric wave bands, as well as for measuring the basic parameters of radio stations.

The development of the "Transport" system and the determination of the list of radio equipment were done on the basis of the analysis of technological processes in transportation, generalization of the determined requirements for the organization of communications in various technological sections of its work and classification of these requirements according to common characteristics. As a result, a minimum list was developed for unified radio equipment and general structural diagrams were determined for radio networks operating in the simplex or duplex mode, with individual or conference calls, with the use of channels for individual or collective use constructed on the radial or linear principle in the hectometric, metric or decimetric bands.

Due to a large volume of scientific-research and experimental-design work, the development of the equipment complex for the "Transport" system is being done in stages.

At the present time, the first stage has been completed: equipment has been developed for the station and, partially, maintenance and operation radio communication which includes chiefly the means of radial radio communication. The developed radio equipment will make it possible to improve the system of controlling the operation of stations and terminals, as well as the work technology of maintenance subdivisions.

In the second stage, test are being done and are nearing completion on the equipment of linear simplex train and maintenance and operating radio communication, as well as the development of train duplex radio communication with individual calls making it possible to transmit analog (telephone mode) and discrete information.

In the third and final stage, it is planned to develop equipment with equally accessible channels operating in the simplex and duplex modes with the possibility of connection to ZhATS, as well as a complex of measuring instruments for serving the "Transport" system.

Due to the difficulty of the introduction of new equipment in the transitional stage, it became necessary to develop special measures. The use of the radio stations RS-23 and RV-3 with frequency synthesizers in the system of station radio communication makes it possible to ensure their joint operation with the radio stations ZhR-U-LS and ZhR-U-SS. Portable radio sets RN-12B operating on five frequencies make it possible to change gradually from the frequency grid of the ZhR-Y complex to the frequency grid of the "Transport" system.

The changeover to the new system of train radio communication was found to be more complicated. In this respect, it was decided to equip train locomotives with two-band radio stations ZhR-UK-LP, which will make it possible to have a channel for the radio communication between the engineers of coupled trains without disturbing the main channel of train radio communication between the engineers, the train dispatcher and assistant stationmasters. The creation of a reliable channel between the engineers of a coupled train will make it possible to solve the important problem of driving heavy-weight trains.

The presence of a two-band radio set on a train locomotive will open up many new possibilities for the organization of effective communication of the engineer with assistant stationmasters when they are on the platform, with automation mechanics when they are checking the brakes, with signalers and foremen of maintenance teams, with guards on trains and at various facilities along the train routes, with persons on duty on the platforms and crew leaders of passenger trains. Moreover, having equipped the locomotive team with portable radio sets RN-12B, it will be possible to maintain communication between the engineer and his assistant when the latter leaves the locomotive in order to guard the train or during its inspection.

This system of train radio communication will make it possible in the first stage of the introduction of the radio equipment of the "Transport" system to equip locomotives at locomotive-building plants with transportable radio stations RV-1 with receivers and transmitters of the hectometric and metric bands, which will ensure total continuity of the two systems of train radio communication.

The radio networks and equipment which are being developed pose new problems in the organization of radio communication and in the improvement of the technological processes of operation in transportation. In this case, it is necessary to develop optimal structures of radio networks for specific technological processes with participation of technologists on the basis of a complex of unified radio facilities having examined the possibilities of improving technological processes with the use of new radio equipment. Moreover, the new radio equipment must satisfy the ergonomic requirements of various categories of users depending on their working conditions.

In order to solve these problems, it is necessary to enlist the cooperation of specialists of all subdivisions of railroad transportation. However, the problems of the organization of radio communication, the structure of radio networks and effective use of radio facilities have to be solved by specialists in the area of radio communication.

The editorial office of this journal is planning to publish a series of articles on the main directions in the development and introduction of the "Transport"

system. The articles will discuss the principles of the construction of radio networks, their existing and expected loads, technical and operational requirements for various radio networks and equipment, ways of solving the problems of electromagnetic compatibility of radio equipment, development of the frequency plan, etc. The articles in this series will describe train, station and maintenance radio communication, the complex of measuring devices, radio communication in subways, remote control and telesignalization devices, as well as normative documents and their main points.

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CSO: 8344/0766

UDC 621.391

CYCLIC CONVOLUTION BY INTERLINKAGE OF DISCRETE FOURIER TRANSFORMATION WITH  
NUMBER-THEORY TRANSFORMATIONS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 29, No 12, Dec 84  
(manuscript received 5 May 82) pp 2342-2346

LABUNETS, V. G.

[Abstract] A hybrid transformation interlinking the fast Fourier transformation and the fast Gauss number-theory transformation is proposed for cyclic convolution involved in digital filtration of signals. This interlinkage utilizes the advantages of number-theory transformation, namely higher speed and absence of internal noise, while it removes the constraint on the signal word length inevitably imposed by limited capacity of a modular arithmetic unit. Other number-theory transformations such as fast Raider-Brenner transformation or fast Nussbaumer polynomial transformation are also considered for interlinkage, each offering an appreciable saving in computation time. Figures 4; references 8: 5 Russian, 3 Western.  
[164-2415]

UDC 621.398.316

EXPERIENCE WITH OPERATION OF TELEMETRIC DATA RELAYING DEVICES

Kiev ENERGETIKA I ELEKTRIFIKATSIYA in Russian No 3, Jul-Sep 84 pp 31-32

STRYABKOV, A. V., engineer, Economic Planning Department, Dnepropetrovsk Regional Administration of Power System Management

[Abstract] Telemetric equipment TM-800 A with data concentrator modules BK-01 and BI-04 gathers data and relays them to a higher level for centralized system monitoring from the dispatcher panel. Data are sampled, relayed, and recorded in one byte according to a "rigid" program. A few deficiencies were discovered in service and have been subsequently corrected. First, the strobe signal was eliminated from the S-100 module by connecting outputs

1 and 2 of the B6 microcircuit so as to allow sequential interrogation of the BK-01 arrays by the BI-04 array in the absence of a "source answer" signal from any one direction. Next, connections were added from the connectors in the S-100 module to the free contactors in the S-930 receiver array so as to avoid rollover of false data received from one direction because of discontinuity in cable or fault in any concentrator circuit to all other directions. It is still necessary to open the connection between output 5 of the EZ microcircuit and output 5 of the G4 microcircuit when a "faulty check point" signal comes in from any one direction so as to avoid triggering the protective device and thus allow correct recording of data received from all other directions during the next two half-cycles. Digital relaying of data has improved the performance and eliminated many extra errors of remote control in the Southern Integrated Power Grid. Figures 1.  
[180-2415]

UDC 621.391.82

#### USE OF MULTICHANNEL INTERFERENCE COMPENSATORS IN COMMUNICATION SYSTEMS

Moscow RADIOTEKHNIKA in Russian No 12, Dec 84  
(manuscript received, after completion, 14 Mar 84) pp 9-16

BYKHOVSKIY, M. A.

[Abstract] The performance of various 2-channel and multichannel interference compensators is reviewed comparatively from the standpoint of applicability to communication systems, specifically short-wave communication via satellite with interference from radio relay lines, and from the premise that single-channel compensators cannot adequately meet the requirements. First is considered a 2-channel compensator with reference input. For operation within a single frequency band its structure includes only two goniometers or 90° phase shifters and two synchronous detectors in an automatic control loop. Otherwise it must be supplemented with extra antennas and low-noise parametric amplifiers. An extension of such a compensator is a multichannel one with adaptive antenna arrays. Next is considered a 2-channel compensator with separation of orthogonally polarized signals, its structure including a differential phase shifter and a differential attenuator separately servomotor-driven in addition to the polarization selector. Most interference compensators are designed for communication systems operating with frequency modulation. Here a suboptimum compensator is structurally much simpler and performs not much worse than an optimum one, especially when signals to be separated lie within the same frequency band. As the number of channels in the radio relay line increases, moreover, typically from 60 to 1020, crosstalk noise in such a 2-channel or multichannel compensator increases by not more than 1.5 dB and thus much less than in the case of autonomous demodulation of FM signals in each channel. The paper was presented to the All-Union Conference on Problems of Electromagnetic Compatibility in Radio Engineering Systems. Figures 9; references 39: 11 Russian, 28 Western.  
[181-2415]

UDC 621.391.037.372:621.391.63

# COMPUTER-AIDED SIMULATION AND OPTIMIZATION OF DIGITAL PHOTORECEIVER

Moscow RADIOTEKHNIKA in Russian No 12, Dec 84  
(manuscript received 16 Dec 83) pp 65-68

KHARUTO, A. V.

[Abstract] A mathematical model of a photoreceiver for digital fiber-optic communication lines is constructed, for the purpose of computer-aided simulation and subsequent design optimization. Design optimization with respect to interference immunity is considered, the latter being characterized by the minimum measurable error probability. In the particular photoreceiver under consideration the signal proceeds from the resistive-capacitive photodetector load to an amplifier-corrector for compensation of frequency distortions. The model includes four noise sources, namely steady dark-current shot noise and nonsteady photocurrent noise along with thermal noise in the load resistor and intrinsic noise in the amplifier-corrector, each characterized by its peculiar spectral density. Limitation of the photoreceiver bandwidth results in intersymbol interference, which together with the trigger level of the threshold device is included in estimation of the error probability. The eight optimizable photoreceiver parameters are split into a group of three (bandwidth, threshold level, threshold decision time) on which the instantaneous optical power of the input signal depends nonmonotonically with a sharp extremum and a group of five (integral sensitivity, dark current, load resistance and capacitance, resistance equivalent of amplifier-corrector noise) on which this power and the error probability error depend monotonically so that their optimization leads to their practically feasible limits. These five parameters are lumped into a "constant" vector and their values are fixed for optimizing the variable three other parameters. The model was used for design optimization of photoreceivers operating at clock frequencies of 1, 2.048, 8.448, 34 MHz in the return-to-zero or in the nonreturn-to-zero mode. Figures 2; references 7: 3 Russian, 4 Western.  
[182-2415]

UDC 621.315.23

# WAYS TO ECONOMIZE COPPER FOR SYMMETRIC HIGH-FREQUENCY CABLES

Moscow ELEKTROSVYAZ' in Russian No 12, Dec 84  
(manuscript received 6 Jun 84) pp 24-27

KASHUTIN, A. A., LAKERNIK, R. M. and NIZAMETDINOVA, F. F.

[Abstract] Since silver and gold are precious and even scarcer than copper, they can hardly be considered as viable substitutes for the latter in communication cables. As substitutes have been considered aluminum and its alloys,

also sodium and iron. One major drawback of aluminum are its lower tensile strength and higher percent elongation, which can be mitigated somewhat by alloying aluminum with other metals. The other drawback is its 60-70% higher electrical resistivity, which requires correspondingly larger conductor sizes and thus increases the cable installation cost. In addition, aluminum and its alloys are prone to corrosion in moist atmospheres, the buildup of high-resistance oxide films being particularly undesirable on contact surfaces. Although aluminum and the AlVc aluminum alloy are the least expensive substitutes for copper, cable production cost being only of the order of 5% higher than that of a copper cable, their large-scale use is still very problematic. Sodium, despite its 2.7 times higher electrical resistivity, could compete with copper on the basis of abundance and cost. Its major drawback, however, is its high chemical activity. Iron, also a much more abundant and less costly metal than copper, has a 2.4 times higher electrical resistivity to which its strong magnetism adds another loss-resistance component. Alternate ways to economize copper for communication cables are design modifications. A tubular construction of copper conductors is most promising, another one being an only partial replacement of copper with aluminum or steel in a bimetallic configuration. In the case of symmetric high-frequency cables, moreover, replacement of lead sheaths with aluminum ones makes it feasible to reduce the diameter of current-carrying copper conductors. Such cables were tested over the 10-1000 kHz frequency range for their most critical performance characteristic, namely crosstalk attenuation. An evaluation of all these methods and consideration of all factors involved indicates that reducing the diameter of solid copper conductors in MKSA cables from 1.2 mm to 1.0 mm is economically most justifiable. Tables 5; references 2 Russian.  
[184-2415]

UDC 621.391.827.21

PROBABILISTIC CHARACTERISTICS OF LINEAR CROSSTALK TO NEAREST KSSP-CABLE  
TERMINAL IN DIGITAL TRANSMISSION SYSTEM

Moscow ELEKTROSVYAZ' in Russian No 12, Dec 84  
(manuscript received 30 Jul 84) pp 32-33

BRESKIN, V. A. and YATSENKO, S. G.

[Abstract] The effect of linear crosstalk to the nearest cable terminal in a single-cable communication system with repeater segments and transmitting quasi-ternary signals is evaluated in terms of the error probability in a repeater segment. The probability distribution density of the instantaneous crosstalk voltage is calculated for this purpose, considering its discreteness and symmetry with respect to zero as well as the randomness of the crosstalk effect. Simulation in the time domain for a KSPP 1x4x1.2 cable, based on known amplitude-frequency and phase-frequency characteristics of linear crosstalk, and taking into account the coding method as well as the rate of

15 May 1985

digital data transmission, reveals that the form of this distribution depends only on the structure adjacent to a repeater segment and can, within 10% accuracy, be approximated as a normal one. The results reveal also that the maximum amplitude and the dispersion of linear crosstalk interference are statistically stable, hardly changing at all after sampling of 40,000 symbols, and that linear crosstalk noise is a stationary process with zero mean. Relations are derived accordingly for the change of dispersion of linear crosstalk at the output of the corrective amplifier and for the effect of truncation of the crosstalk distribution on the error probability as well as on the length of a repeater segment. Crosstalk truncation is found to allow lengthening a repeater segment by approximately 12-16%, equivalent to reducing its immunity to internal noise from 22 to 18 dB without exceeding the error probability of  $10^{-10}$ . References 6: 5 Russian, 1 Western.  
[184-2415]

UDC 621.373.826:621.396

## ESTIMATING DISPERSIONAL DISTORTIONS IN OPTICAL CABLES

Moscow ELEKTROSVYAZ' in Russian No 12, Dec 84  
(manuscript received 26 Dec 83) pp 34-36

TUROV, V. G., ALISHEV, Ya. V., MAR'YENKOV, A. A., URYADOV, V. N. and  
SINKEVICH, V. I.

[Abstract] Dispersion in optical cables distorts transmitted signals and, together with their attenuation, determines both the transmission range and the transmission rate. Distortion caused by dispersion can be determined from the pulse response characteristic of a fiber, for consideration in correction of cable design and technology. Since the minimum product of attenuation and pulse response width, the latter measured at 0.5 or preferably at 0.1 of the maximum pulse amplitude, does not yield precise estimates of the transmission coefficient; simulation of an actual transmission system including a model of an optical receiver sensitive to dispersive distortion is preferable. The performance with such a receiver is evaluated in terms of signal power necessary for not exceeding a given error probability at a given noise power depending on the circuit parameters. A receiver with bipolar transistors in the input stage is considered for optical communication systems with transmission rates higher than 30-40 Mbit/s. Using such a receiver, it is possible to calculate the increase of attenuation and the increase of bandwidth caused by mechanical stresses in the process of tightly sheathing optical fibers into a cable. Calculations reveal an interrelation between change in attenuation and change in bandwidth, also the effect of these changes on the transmission characteristics. Numerical data for a specific optical cable with a 250 m long fiber segment and 1.5 dB nominal attenuation indicate that in this case the increase of attenuation and bandwidth is less detrimental to the transmission characteristics at rates above 160 Mbit/s than at rates below 160 Mbit/s. Figures 3; references 3 Russian.  
[184-2415]

INCREASING INTERFERENCE IMMUNITY OF MODIFIED HUFFMAN CODE

Moscow ELEKTROSVYAZ' in Russian No 12, Dec 84 (manuscript received 3 Aug 82)  
pp 37-40

BAL'KIN, G. F., GOLOSNOY, V. I., ZAYCHENKO, A. G., MIKHALINA, N. B. and  
SAPUNKOV, M. N.

[Abstract] Several method of increasing the interference immunity of facsimile transmission in the modified Huffman code with CCITT group-3 apparatus are evaluated comparatively, this code having been found to perform better than all other known statistical codes in terms of compression and error sensitivity. The basic three methods are redundant coding, masking the distortions, and limiting the length of distorted segments. Redundant coding greatly reduces the channel capacity and complicates the hardware as well as the software, requiring large memories and a return channel. Masking the distortions is not very efficient at high error probability or low scan density. There are various techniques available for limiting the length of distorted segment, whose gist is to shorten the error track which forms upon appearance of an error and exists till the next synchronizing line combination (EOL) enters. The simplest technique is cutting a line into segments and increasing the number of synchronizing combinations, but this also entails an appreciable reduction of channel capacity. Restoring a line and localizing a distorted segment by means of interline correlation analysis from beginning to end of the distorted line is more effective in the case of single errors and quite ineffective in the case of error culsters. Localizing an error on the basis of information about the channel signal at the modem receiver input and about the decoded lengths of symbol series is applicable only in systems with active cause. Shortening the error track by cutting a line into segments without transmission of extra synchronizing combinations is most promising and involves dividing a line into equal segments prior to encoding and analyzing each segment for presence ("1") or absence ("0") of black-to-white and white-to-black transitions. Such a preliminary description precedes proper encoding of all series of nonempty segments, except the last one, with the codes of any one nonempty segment separated from the codes of the next nonempty segment either by addition of a special marking bit, or by addition of a quasi-separating combination which need not be interference immune and can be short, or by transmission of information about the number of code pulses (combinations) in each nonempty segment. The algorithm of such encoding with line cutting and preliminary description appreciably increases the interference immunity of the modified Huffman code and only slightly decreases compression. This becomes evident upon referring to CCITT Document 4. Figures 3; tables 1; references 12: 5 Russian, 4 Western, 3 CCITT.  
[184-2415]

ORGANIZATION OF PROGRAM GENERATION CENTERS FOR AUTOMATIC LONG-DISTANCE  
TELEPHONE OFFICES

Moscow ELEKTROSVYAZ' in Russian No 12, Dec 84 p 42

MONINA, G.

[Abstract] A report on "Organization of Program Generating Centers for Automatic Long-Distance Telephone Offices" was presented in April 1984 to the Scientific and Technical Council at the USSR Ministry of Communication. Such centers are being installed in Soviet-made "Kvarts", ARYe and AKhYe offices as well as foreign-made imported ones such as "Metakonta-10S", at a steadily accelerating pace so that already 17 offices will have such centers by the end of 1985. The program array developed at the Central Scientific Research Institute of Communication for the first-generation quasi-electronic "Kvarts" office in Vilnyus consists of 800 kbytes documented on 6300 pages in 250 books and on 10,000 listing sheets, allowing about 20 bytes (digits) for each input and output. The program generating center must be incorporated into an existing technical service center or be organized as a separate one. Program generating centers are also recommended for automatic local telephone offices.  
[184-2415]

UDC 621.311.6.072

REMOTE POWER SUPPLY FOR LINE REPEATERS OF IKM-480 APPARATUS

Moscow ELEKTROSVYAZ' in Russian No 12, Dec 84 (manuscript received 4 Apr 83)  
pp 43-46

GAAZE, V. B.

[Abstract] A remote power supply for unattended IKM-480 line repeaters is described, in a system with the maximum distance between attended repeaters equal to 200 km and the nominal spacing of unattended repeaters between them equal to 3 km. Power is fed to each unattended repeater from the attended ones at both ends of a repeater segment, over the center conductors of MKT-4 coaxial cable pairs. The performance of this power supply is determined largely by the characteristics of the power feed stage of the repeaters, instability of the repeater feed voltage detrimentally affecting the data transmission fidelity, and the efficiency of the power supply determines the maximum spacing between repeaters. A compensation-type voltage stabilizer is used with IKM-480 pulse-code-modulation apparatus, a parametric stabilizer being less efficient here and having a lower voltage stabilizing capability. Power is drawn for a -45 or -60 V d.c. network. High voltage is produced by chopping and transformation at a frequency of 16 kHz, the supply current is stabilized by means of pulse-width regulation. High reliability is ensured by adequate standby capacity, the more sturdy power components occupying most of the enclosure while the intricate and thus

of that point for necessary interference immunity. It also separates signal processing in the filter from interference suppression in the compensating channel and, accordingly, allows optimization with respect to interference immunity in the compensating channel so that the filter can be optimized with respect to efficiency or according to any other criterion. One such criterion is maximum signal-to-interference ratio at the output. Each mode of optimization is readily extendable to filtration of a multidimensional input vector additively mixed with an interference vector. Next is considered filtration of nonstationary vector processes which is solved by the Kalman method. Calculations are shown first for the simple special case of a compensating channel with interference only and then for the general case of interference as well as a useful signal in the compensating channel. Figures 4; references 6: 5 Russian, 1 Western (in Russian translation). [182-1415]

UDC 621.396.677.71

#### EXTERNAL SELF- AND MUTUAL ADMITTANCES OF SLOTS IN VICINITY OF RIDGES

Moscow RADIOTEKHNIKA in Russian No 12, Dec 84  
(manuscript received, after completion, 22 Dec 83) pp 61-63

OZNOBIKHIN, V. I.

[Abstract] The external self- and mutual admittances of rectangular radiator slots in an array between straight ridges are calculated, assuming an absence of internal rereflections. Both self- and mutual admittances are regarded as consisting of three components. The first component is the external admittance of slots in an infinitely large conducting plane. The second and third components represent respectively first and second diffraction orders, the former a sum of  $N$  terms corresponding to the number of ridges and the latter a sum of  $N_2$  terms corresponding to the number of secondary diffraction sites. Higher diffraction orders are disregarded. Numerical results are shown for an array with  $N = 4$  and  $N_2 = 14$ , namely all conductances and susceptances as functions of the distance between slots in troughs of various widths, also self-conductance and self-susceptance of a slot as functions of the trough width with the ridges slanting at various angles. Figures 3; references 4: 3 Russian, 1 Western. [182-2415]

UDC: 621.396.677:621.317.08

DETERMINATION OF ANTENNA RADIATION PATTERN FROM FIELD MEASUREMENTS IN  
FRESNEL ZONE

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 27, No 11, Nov 84 (manuscript received 26 Mar 84 after revision)  
pp 106-108

SOLOVTSOV, S. L.

[Abstract] An algorithm is proposed for processing the results of field measurements in the Fresnel zone in which a system of linear equations is solved, followed by interpolation with respect to a Kotel'nikov series. The method is reasonably fast, and often makes it possible to reduce the pattern determination error as compared with existing methods. The approach can be extended to the three-dimensional case by applying the described procedure to the rows and columns of two-dimensional files of experimental data. References 4 Russian.  
[146-6900]

UDC: 621.391.2

OPTIMAL SPACE-TIME PROCESSING OF WEAK SIGNALS CREATED BY ELONGATED OBJECTS

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 27, No 11, Nov 84 (manuscript received 18 Jan 84 after revision) pp 78-81

[Abstract] This study investigates the possibility of approximating an optimal space-time processing algorithm by a simpler quasi-optimal algorithm for receiving a signal reflected by an elongated object against the background of space-time white noise. Analytical expressions are derived for the conditions under which the quasi-optimal algorithm is near optimal; the influence of the dimensions of the object and the parameters of the received antenna and emitted signal on the approximation accuracy is analyzed. It is found that the use of large antennas, complex signals and short wavelengths to improve the resolution of instrumentation radio systems simultaneously supports the conditions for employing a simpler realization of the optimal processing system. References 5 Russian.  
[146-6900]

UDC: 621.396.67

ANALYSIS OF EFFICIENCY LOSSES OF ADAPTIVE ANTENNA ARRAY WITH ERRONEOUS  
ESTIMATES OF WEIGHT COEFFICIENT VECTOR

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 27, No 11, Nov 84 (manuscript received 16 Mar 84 after revision) pp 81-82

POPOV, A. S.

[Abstract] A remote-controlled adaptive antenna array is examined in which control channel noise causes errors in the weight coefficient vector components, reducing the effectiveness of the array. The average efficiency of the array is found to drop as the variance of the components of the optimal weight coefficient vector increases. The slope of the relative change in efficiency increases as the dimensionality of the weight coefficient vector and combined interference level. A formula is derived that makes it possible to validate the acceptable standard deviation of the errors of the components of the weight coefficient vector, and thus to assign the requirements for the feedback channel. References 4 Russian.  
[146-6900]

UDC: 621.396.677

CALCULATION OF REFLECTIONS FROM SURFACE OF RADIO ABSORBING MATERIAL

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 27, No 11, Nov 84 (manuscript received 15 Dec 83) pp 103-105

INSPEKTOROV, E. M.

[Abstract] Reflections from the surface of radio absorbing material employed in anechoic chambers is investigated. A method is proposed that makes it possible to determine the optimal geometry of the surface of the radio absorbing material for given field sources in order to minimize the reflected field and the overall dimensions of the device, and to determine the level of the reflected field in relation to the primary field. The method is sufficiently universal, and can be employed in solving a number of problems of electrodynamics. References 6: 5 Russian, 1 Western.  
[146-6900]

MICROWAVE THEORY AND TECHNIQUES

UDC 537.8.029.6

PERIODIC GRATINGS WITH HIGH SPACE FREQUENCY FOR FUNCTIONAL MILLIMETER-WAVE  
AND SUBMILLIMETER-WAVE DEVICES

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 29, No 12, Dec 84  
(manuscript received 28 Jul 83) pp 2323-2328

AYVAZIAN, M. Ts., KAZANTSEV, Yu. N. and KOPNIN, A. N.

[Abstract] Passage of an electromagnetic millimetric or submillimetric wave through an array of  $N = 3$  parallel periodic gratings in free space is analyzed, each grating formed by parallel ideally conducting cylindrical conductors with a space period much smaller than the wavelength. The gratings are arbitrarily spaced and the orientation of conductors is different in each. The two orthogonal components of the electric field vector transverse to the direction of wave propagation, each consisting of a transmitted part and a reflected part  $180^\circ$  out of time phase, are determined for  $N + 1 = 4$  regions of space: two half-spaces beyond the two outer gratings and two plane-parallel space layers between those and the inner one. This establishes a system of equations for reflection coefficients and transmission coefficients with appropriate boundary conditions, the last grating adding four equations with four unknowns to the system. Two special devices realizable with such an array of three gratings are described, to demonstrate the improvement of electrical characteristics over those of arrays of only two gratings. These devices are a reciprocal polarization-plane rotator and a variable attenuator. In the latter case the distances between gratings, all inclined at  $45^\circ$  to the direction of wave propagation, are selected for minimum frequency dependence of the transmission coefficient and minimum conversion of the active wave into high-order harmonics. Figures 4; references 9 Russian.

[164-2415]

UDC 538.3

ALLOWANCE FOR SINGULARITIES AT EDGE DURING CALCULATION OF PARAMETER  
CHARACTERISTICS OF SHIELDED SLOT LINES

Gor'kiy IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOFIZIKA  
in Russian Vol 27, No 12, Dec 84 (manuscript received 21 March 84)  
pp 1602-1605

LERER, A. M. and OTMAKHOV, Yu. A., Rostov'on-Don State University

[Abstract] An allowance for singularities of the metal edge is widely used during calculation of the parameters of waveguides with a complex form of the cross-section of microstrip, slot, and waveguide-slot lines. Integral and integrated differential equations used in the process are solved by the Galerkin method, the basic functions of which are weighted Chebyshev polynomials, taking into account the singularities of behavior of the electromagnetic field at the metal edge. The basic stages are examined of the numerical realization of the Galerkin method with a weighted base. Calculations are quoted only for symmetrical shielded slot lines (EShchL). For nonsymmetrical EShchL, calculations are analogous but more cumbersome. Figures 1; tables 2; references 9 Russian.

UDC 621.372.413:621.372.8

FABRY-PEROT RESONATOR WITH SLOTTED COMMUNICATION ELEMENTS

Gor'kiy IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOFIZIKA in Russian  
Vol 27, No 12, Dec 84 (manuscript received after revision, 4 July 84)  
pp 1600-1602

PAVEL'YEV, V. G. and TSIMRING, Sh. Ye., Gor'kiy State University

[Abstract] Although Fabry-Perot resonators have high selectivity, the problem of continued rarification of the spectrum is important for them and is examined in the paper. A system of Fabry-Perot resonators connected through a slot is considered. In the connected system, the spectrum contains cophasal and antiphasal normal oscillations. With the use of a half-wave coupling slot, it is shown that discrimination exists of the cophasal oscillations and the free oscillations of the individual resonators. This results from the presence of a strong electrical field on the slotted communication elements and consequently only the antiphase oscillations of the system, having an uncommon spectrum, are caused by the Q factor, calculation of which is complicated because of the necessity for consideration of the nonresonance background contained in the spectrum of the open resonators. Corresponding radiation losses of the resonators can be estimated with the assumption that radiation of the slot results directly in open space. Figures 1; references 3 Russian.

UDC 621.385

## NONLINEAR NONSTATIONARY EQUATIONS OF INTERACTION BETWEEN AN ELECTRON BEAM AND ELECTROMAGNETIC FIELD NEAR THE BOUNDARY OF THE BRILLOUIN ZONE

Gor'kiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian  
Vol 27, No 12, Dec 84 (manuscript received 25 Nov 83) pp 1575-1583

KUZNETSOV, A. P. and KUZNETSOV, S. P., Saratov State University

[Abstract] Equations are formulated which describe the nonstationary processes in the system electron beam - electromagnetic field near the boundary of the Brillouin zone in the limits of the wave approach. In an applied plane the results of this work can be useful during investigation of nonstationary and pulse processes such as in relativistic Cerenkov generators. Detailed consideration is given to: 1) Nonstationary equations of excitation of electromagnetic structure; 2) Equations of motion; 3) Setting up of boundary conditions for field; 4) Complete formulation of boundary value problem; and 5) Some numerical results. The authors thank D. I. Trubetskov for attention to the work and L. V. Bulgakov for assistance in programming the problem and conducting numerical calculations. Figures 4; references 10 Russian.

UDC 621.372.832.8

## MODERN MILLIMETRIC-WAVE FERRITE DEVICES

Moscow RADIOTEKHNIKA in Russian No 12, Dec 84  
(manuscript received, after abridgment, 13 Feb 84) pp 16-25

BOCHKAREV, A. I.

[Abstract] The state of the art and the development trends in millimetric-wave nonreciprocal ferrite devices are reviewed, mainly from the standpoints of performance optimization and miniaturization to the circuit integration level. The most outstanding applications for ferrites are Y- or T-circulators and H- or E-plane diode-flange sets. Their analysis and synthesis are based on the scattering matrix for multilayer and anisotropic media with extensive use of electrodynamic modeling and numerical methods, techniques already successfully used for microwave devices. A recent achievement is a ferrite diode with Chebyshev frequency characteristics. The scope of applications continues to expand, very promising being diode-modulator and diode-transformer sets, filters and phase shifters and devices which functionally combine filter matching and protection. Figures 6; references 80: 38 Russian, 42 Western (2 in Russian translation).  
[182-2415]

UDC: 621.372

METHOD OF PARTIAL DOMAINS IN PROBLEMS OF MODELING AND DESIGNING MULTILAYER INTEGRATED MICROWAVE CIRCUITS

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 27, No 11, Nov 84 (manuscript received 9 Apr 84 after revision) pp 3-9

VESELOV, G. I. and NIKOLAYEV, M. A.

[Abstract] A diffraction approach to analyzing the natural waves of multilayer lines is investigated. The electromagnetic field in this version of the partial domains method is represented as the superposition of the incident and scattered natural waves of the partial domains. The base problem is that of the diffraction of the natural waves of the domains on a partially metallic boundary. A slot stripline and a multiconductor stripline, as well as diffraction at the junctions between different types of lines, are analyzed as examples. Computer analysis indicates that the algorithms are highly effective for modeling the base elements of multilayer microwave integrated circuits at the electrodynamic level. References 8 Russian.  
[146-6900]

UDC: 621.372.832

CASCADED DIFFERENTIAL PHASE INVERTERS FOR MICROWAVE BAND

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 27, No 11, Nov 84 (manuscript received 11 Apr 84) pp 14-19

GORBACHEV, A. P., KUPRIYANOV, A. M. and NEVEROV, S. G.

[Abstract] The transfer functions of differential phase inverters for the microwave band are analyzed. A method is proposed for simplifying the implementation of differential phase inverters without increasing their length by expanding the transfer function of the device into a series of simple first- and second-order functions that can be realized easily by one- and two-section directional couplers. The scattering matrix elements and transfer functions of single-, two- and three-section phase inverters are analyzed. Studies of an experimental cascaded phase inverter in the microwave band are described. References 16: 11 Russian, 5 Western.  
[146-6900]

UDC: 621.372.832

DIRECTIONAL COUPLERS FOR COMBINED MULTIMODE POWER EMPLOYING  $\Pi$ -WAVEGUIDES

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 27, No 11, Nov 84 (manuscript received 19 Dec 83) pp 56-59

GAL'CHENKO, G. A., GAL'CHENKO, N. A., MIKHALEVSKIY, V. S. and CHEKRYGINA, I. M.

[Abstract] The crosstalk attenuation of multimode power directional couplers employing  $\Pi$ -waveguides is investigated assuming and equiprobable distribution of the complex amplitudes of all types of wave propagating. The alternating Schwartz method is employed to find the function describing the field distribution of the  $H_{10}$  wave in the  $\Pi$ -waveguide. The use of  $\Pi$ -waveguides with relative frequency overlap of 3.6:1 as secondary collectors makes it possible to replace the three different constructions ordinarily employed for rectangular waveguides with a single common construction. The method and analysis make it fairly simple to implement the parametric synthesis of such devices, and to reduce the amount of expense of experimentation required.

References 6: 4 Russian, 2 Western.

[146-6900]

BROADCASTING, CONSUMER ELECTRONICS

UDC 621.395.623.54.001.63

METHOD OF DESIGNING LOW-FREQUENCY HORNS

Moscow TEKHNIKA KINO I TELEVIDENIYA in Russian No 12, Dec 84 pp 18-23

VYLCHEV, P. I. (Bulgaria)

[Abstract] A new method of designing low-frequency horns is proposed, using an acoustic equivalent series circuit and an electric equivalent parallel circuit with parameters directly obtainable from the respective impedance characteristics. The horn consists of an electrodynamic head with a diffuser and a hyperbolic-exponential profile. Through its exit aperture it feeds a closed space, the space between diffuser membrane and the entrance aperture being generally idle. The efficiency, namely ratio of acoustic output power to electric input power, is calculated for the intermediate range of operating frequencies. The sensitivity is calculated for the range near the upper cutoff frequency, at which it must be maximized. Compensation of reactances by matching of volumes is necessary for the range near the lower cutoff frequency. The design procedure based on these criteria consists of optimizing the exit aperture for maximum power to the load, maximizing the diffuser displacement within permissible limits for development of maximum acoustic power, then minimizing the inductance of the audio coil and the volume of the entrance space before the diffuser membrane so as to shift all frequency-dependent parasitic effects beyond the upper cutoff and thus maintain a uniform performance level throughout the operating frequency range. All these principles have been applied to the design of the "NIVOKS" woofer with 108 dB sensitivity over the 80-800 Hz frequency range, 12 dB lower cutoff 65 Hz and 12 dB upper cutoff 950 Hz, with a nominal input impedance of 12 ohms and drawing a nominal electric power of 100 W. The woofer was tested in an anechoic chamber as well as in open space. Figures 9; references 9 Western.  
[179-2415]

UDC 621.397.13.029.7

# TRANSMISSION OF TELEVISION SIGNALS OVER FIBER-OPTIC COMMUNICATION LINES

Moscow TEKHNIKA KINO I TELEVIDENIYA in Russian No 12, Dec 84 pp 24-26

GRINSHTEYN, M. L., KIRILLOV, V. I., MAL'TSEVA, N. V., SERIKOV, V. V. and  
TKACHENKO, A. P., Minsk Institute of Radio Engineering

[Abstract] The main problem in transmitting television signals over fiber-optic communication lines with direct intensity modulation of the carrier is holding nonlinear distortions to a minimum, below 2%, while maintaining a high signal-to-noise ratio, above 50 dB. Nonlinear distortion increases with increasing modulation depth, essentially because of the excessively nonlinear power-current characteristic of laser diodes. Other modulation methods are therefore used, generally in two stages with amplitude modulation in the second stage. Since modulation by analog-pulse methods rather than by digital methods is preferable for transmission over short distances not exceeding 100 km and since frequency modulation is used predominantly in conventional television systems, pulse-frequency modulation in the first stage has been selected as the most expedient method for transmission over fiber-optic lines. The necessary conversion from frequency modulation to pulse-frequency modulation is simple, requiring only an amplitude limiter and a shaper of constant-duration pulses. A resistance-capacitance-tuned oscillator in the form of an emitter-coupled multivibrator has been selected as source of FM signals, in preference to an LC oscillator and a heterodyne oscillator less easily realizable in discrete-circuit version with a sufficient degree of linearity. Standard KEM-34 laser modules have been selected for the optical transmitter and receiver, with a Chebyshev low-pass filter for demodulating pulse-frequency modulated signals or with a frequency discriminator for demodulating FM signals in the latter. Transmission lines up to 2 km long were assembled by splicing segments of multimode fibers with 60  $\mu$ m core diameter. The half-power bandwidth, limited by dispersional distortions, was 20 MHz over a 1.5 km distance. An autocorrelational electric frequency detector with frequency doubling and nonlinear threshold processing was inserted before the demodulator for interference suppression. Nonuniformity of the amplitude-frequency characteristic and its drop at the upper cutoff frequency (6 MHz), time delays of brightness and color-difference signals, nonlinear distortion of the brightness signal, differential gain, "chrominance-luminance" distortion, signal-to-noise ratio and overall losses in the optical channel were measured at 20°C and at 50°C. In addition, the image quality was checked on the screen of a television monitor according to the UFIT table. Figures 2; tables 1; references 6 Russian.  
[179-2415]

UDC 621.397.611.13M

VIDEO CHANNEL AND SELECTION OF FORMAT FOR SECOND-GENERATION MAGNETIC  
VIDEO-AUDIO TAPE RECORDERS

Moscow TEKHNKA KINO I TELEVIDENIYA in Russian No 12, Dec 84 pp 26-28

SLUTSKIY, I. A. and SMIRNOV, B. Ya.

[Abstract] A video channel with digital rather than analog phase-lock automatic frequency trim is proposed for magnetic video-audio tape recorders. It includes clock and byte synchronization with memory, also a playback amplifier and a phase-frequency corrector for phasing the receiver channels. Conversion to large-scale integration with all-digital components and high recording-channel density in thin-film magnetic heads will be made feasible by application of available microelectronic techniques. A major problem is ensuring an adequate resolution at high tape speeds, tape with perpendicular anisotropy being most suitable for use with stationary recording and playback heads. Current-sensitive and frequency-insensitive magnetoresistive thin-film magnetic heads are most appropriate for high-density longitudinal recording at tape speeds within the 4.76-7.1 cm/s range, their otherwise serious drawbacks such as nonlinear distortion and difficult channel separation being insignificant in the case of digital recording. The formats of modified non-return-to-zero modular 8/10 encoding of a standard 4:2:2 television signal in channels according to a table stored in the read-only memory with subsequent modulation, designed for 3.81 mm wide and 6.25 mm wide tapes with perpendicular anisotropy, will be compatible with primary studio recording equipment as well as with studio or field transcription equipment. Figures 4; tables 1; references 13: 7 Russian, 6 Western. [179-2415]

UDC 621.397.13:778.4

MAXIMUM PARALLAX IN STEREOSCOPIC TELEVISION SYSTEM

Moscow TEKHNKA KINO I TELEVIDENIYA in Russian No 12, Dec 84 pp 29-31

NAVOLOTSKIY, Yu. A.

[Abstract] The maximum parallax in a stereoscopic television system has been determined on the basis of experiments, as function of two parameters: sharpness of image separation in the stereoscopic pair and bandwidth of either one channel  $\Delta f$ . The sharpness of image separation was evaluated in terms of the crosstalk factor  $K_c$ , under equal luminance loads on both channels. Measurements were made by the method of polaroidal separation with rotatable ocular filters and with adjustable convergence of optical axes, according to a 2-factorial plan based on the model  $X_{ijk} = \mu + K_n(i) + \Delta f_1 + K_n \Delta f_1(j) + c_k(ij)$ . With the bandwidth of the right-eye channel fixed at 4 MHz, the bandwidth of the left-eye channel

was varied from 4 to 0.5 MHz. Tests were randomized so as to eliminate the influence of extraneous factors such as time instability of image parameters and fatigue of examiners. Instead of increasing the parallax from near zero to the tolerance limit and beyond, as had been done in earlier experiments, here the parallax was intentionally set above the tolerance limit and the examiners asked to reduce it to within the tolerance limit by rotating the polaroid oculars. This appreciably shortened the viewing time at extreme parallax levels and thus avoided fast overloading of the examiners' eyes. Images with various depths of vision were used for the tests. The readings were then processed by dispersion analysis, with use of mean-square values and application of the Fisher significance test, appropriate for statistical evaluation of the parallax parameter with a distribution apriori known to be a normal one. Figures 2; tables 2; references 12: 8 Russian, 4 Western (1 in Russian translation).  
[179-2415]

UDC 621.397.6.049.77

ANALOG-TO-DIGITAL CONVERTER USING SERIES 1107PV1 INTEGRATED MICROCIRCUITS FOR TELEVISION

Moscow TEKHNIIKA KINO I TELEVIDENIYA in Russian No 12, Dec 84 pp 31-34

GOZBENKO, V. P. and TSYKALO, N. D.

[Abstract] An analog-to-digital converter has been designed on the basis of series 1107PV1 integrated microcircuits for implementation of digital techniques in analog television systems. Quantization of a full color signal into the required 256 levels occurs in a parallel array of four 6-bit converters, with the dynamic range of the analog signal subdivided into four subranges for separate quantization in each subrange. The output codes of all four 6-bit converters are added up into an 8-bit resultant code. A full color signal is amplified and bilaterally limited, while its spectrum is truncated by a low-pass filter, then shifted into the negative range for matching with the dynamic range of the analog-to-digital converter. The latter contains only 63 comparators with input transistors, the zero level of an analog signal being transmitted in the initial converter code. It also contains transistor-transistor logic before the code adder and a register on the output side. The converter requires five supply voltage levels for its components: -5.2 V, +12 V, -12 V, -6 V, +5 V with the current drain not exceeding 1.1 A, 200 mA, 300 mA, 600 mA, 400 mA respectively. Its parameters are checked and regulated in an encoder-decoder set with the aid of standard analog television test signals. Non-linear distortion of the "differential gain" kind is monitored by means of a 4.43 MHz 5-step ladder signal with sinusoidal cap. Nonlinear distortion of the "differential phase" kind is monitored by means of a 4.43 MHz sawtooth signal with sinusoidal cap. Both distortions are minimized by adjustment of appropriate capacitors in the amplifier-limiter array. A prototype of this SV-24 analog-to-digital converter has been incorporated in the SK-81 line synchronizer and successfully tested therein. Figures 6; references 3: 2 Russian, 1 CCIR.  
[179-2415]

UDC 621.397.13

EFFECT OF DISCRETIZATION AND QUANTIZATION OF VIDEO SIGNAL ON RESOLVING POWER  
OF RADIOMETRIC TELEVISION SYSTEM

Moscow RADIOTEKHNIKA in Russian No 12, Dec 84 pp 35-36

[Annotation of article No 381 deposited at Central Scientific and  
Technical Institute 'Informsvyaz', 16 pp with 6 figures and 8 biblio-  
graphic references]

TROYNOY, G. L.

[Abstract] Time discretization and level quantization of a video signal in a radiometric television system are considered with discretization at constant frequency with or without integration of the signal between samples and assuming that the signal will be restored by rectangular interpolation. The resulting error in transmission of an image element is estimated in terms of its statistical characteristics, namely mathematical expectation and dispersion of the random component, depending on the noise level at the analog-to-digital converter input. Radiometric accuracy and visual resolution are determined by the error of integral luminance and the error of integral luminance drop, respectively, the latter depending on the width of the background zone around an image element. This width and both errors are calculated for square and circular test image elements, the latter being replaced with an area-equivalent square one. The noise level at the converter input can then be optimized for maximum accuracy or resolution within the linear range of the amplitude characteristic of the video channel.

[182-2415]

UDC 621.317.353

SHAPING CLEAN FREQUENCY-MODULATED SIGNAL OVER WIDE FREQUENCY RANGE

Moscow RADIOTEKHNIKA in Russian No 12, Dec 84  
(manuscript received, after completion, 20 Feb 84) pp 69-72

PAVLENKO, Yu. F. and BOLMUSOV, Yu. D.

[Abstract] The problem of shaping clean FM signals over a wide frequency range for testing transmitters and receivers in mono- or stereophonic broadcasting systems, radio relay or ground-level communication systems has been solved with an instrument built on the basis of the K2-38 standard reference checker of frequency-deviation meters. It consists of three modules, a generator of modulating voltage followed by a generator of FM signals with a generator of discrete-frequency signals on the output side. The first module contains a low-frequency oscillator and a frequency divider. The second module contains a distortion compensator, a 10 MHz FM oscillator,

a 10 MHz quartz oscillator, a 50 MHz FM oscillator, two frequency quintuplers, an electronic commutator, a frequency-deviation calibrator, a ripple meter, and an AM meter. The ripple factor is measured by the method of combination frequencies. The parasitic amplitude modulation is measured by the compensation method. Also parasitic frequency modulation and frequency noise are measured for certification of a clean FM signal. The third module contains an array of quartz oscillators and frequency multipliers covering a 1-1000 MHz frequency grid, also certifiers of modulating voltage signals, frequency-modulated signals, and discrete-frequency signals respectively. Test signals at the output of this instrument have a ripple factor within 0.01-0.05% characterizing their nonlinear distortion. With the aid of a heterodyning frequency converter and a low-pass filter, FM signals from the K2-38 set can be stepped down into the 1-500 MHz range or into the 1-250 MHz range with uniform amplitude-frequency characteristic. Figures 3; references 6: 5 Russian, 1 Western.  
[182-2415]

UDC 621.396.97:681.84.087.7

## DIGITAL STEREOPHONIC BROADCASTING SYSTEM

Moscow ELEKTROSVYAZ' in Russian No 12, Dec 84  
(manuscript received 10 Jun 83) pp 1-3

KOLESNIKOV, V. M. and BANK, M. U.

[Abstract] A digital ultrashort-wave radio broadcasting system has been proposed for transmitting either five high-fidelity stereophonic programs or two monophonic and four stereophonic ones all at the same 4 MHz carrier frequency over the 100-104 MHz channel. The digital part of the system consists of a signal shaper, a signal feeder, a transmitter with peripheral equipment, a transmission line, and a receiver with peripheral equipment. Unlike its analog counterpart, this digital system is a multichannel one with time division of channels and double phase-difference modulation. All programs are fed to the transmitter after conversion from linear pulse-code to floating-point pulse-code modulation for a much better symbol economy. Signals from both stereo channels undergo double phase-difference modulation in the transmitter. They can then be transmitted at a rate as high as 4096 kbits/s ( $6 \cdot 128 + 32 = 800$  bits per stereo channel, five channels for five programs requiring  $2000 + 2000$  bits/ $\mu$ s with 48 "spare" bits in each period). A higher transmission rate is not feasible in an urban environment with a high density of propagating metric waves. For transmission over a communication line which also carries other signals, especially long-wave ones, the stereophonic programs are additionally protected against errors by means of the BCHKh(127,99,10) iterative high-speed code. A receiver contains a digital tuner and a digital decoder, it operates in the straight amplification mode. The digital tuner consists of an antenna amplifier and a phase demodulator, a phase-difference-modulation detector containing an analog multiplier and surface-acoustic-wave delay line serving as the phase demodulator. The tuner

extracts the useful high-frequency signal and converts it into the original digital data flux, whereupon it generates a clock-frequency signal for running the decoder. Such a receiver is smaller in overall size than 50-75 W "Hi-Fi" receivers and draws less power, thus being more efficient, while producing sound of the same high quality. Digital stereophonic radio broadcasting with this equipment was successfully tried on an experimental basis in 1982-83 in Leningrad. References 3 Russian.  
[184-2415]

UDC 621.396.97.029.6

SELECTION OF SYSTEM FOR STEREOPHONIC SOUND TRACKING OF TELEVISION BROADCASTS IN USSR

Moscow ELEKTROSVYAZ' in Russian No 12, Dec 84 (manuscript received 3 Nov 83)  
pp 4-6

KORGUZALOV, V. V. and KALININ, L. B.

[Abstract] Three stereophonic sound tracking systems are considered for operation with radio-television power transmitters in the USSR, about 100 new ones (ATRS-5/1, ATRS-50/5, "Il'men'") and about 400 older ones ("Yakor'", "Uragan", "Len", "Don"), compatibly with the existing 90 million home receiver sets. These systems are a Soviet one with polarity modulation, a Japanese FM-FM system (IEEE Trans. Broadcasting, Vol 25, No 4, 1979), and a West German system with two carriers (TEST, No 10, 1981). The selection must be based on the principal requirement of high fidelity and high cost effectiveness with high immunity to interference from video channel, sweep channels, and power supplies. It is necessary to consider that single-channel reception, with beating of video carrier and audio carrier, is the standard method in modern television sets. With the signal-to-interference ratio dropping to 0-6 dB, especially in color television sets, this method is unacceptable for stereophonic sound tracking. Quasi-parallel reception with two carriers reduces the interference level by 40 dB, but does not suppress parasitic phase modulation of difference-frequency signals. Using the FM-FM system requires development of a narrow-band piezoceramic filter for 922.5 and 982.5 Hz identification frequencies. Most promising, therefore, is the Soviet system after channel separation with a corrective network for the complex stereophonic signal has been included. Only digital transmission of sound and image is equally promising. Figures 5; references 8: 4 Russian, 4 Western.  
[184-2415]

UDC 621.396.97

IMPROVING PERFORMANCE OF UHF FM BROADCAST TRANSMITTERS IN CASE OF MISMATCH  
IN ANTENNA

Moscow ELEKTROSVYAZ' in Russian No 12, Dec 84 (manuscript received 23 May 83)  
pp 9-12

KALININ, L. B.

[Abstract] The performance of UHF FM broadcast transmitters is evaluated, taking into consideration mismatch in the antenna circuit. The deviation of electroacoustic performance parameters from their values corresponding to a matched load is estimated, as the standing-wave ratio increases from nominal 1-1.11 to 1.25-1.4 with 100-500 m long antenna feeders. Calculations are based on the equivalent circuit for several transmitters feeding a common multitier antenna through a VHF separating filter, with the antenna represented by a resistance which also determines the reflection coefficient. Calculation take into account that the bandwidth of an FM signal  $u = U \sin(\omega_0 t + m \sin \Omega t)$  with a modulation index  $m > 1$  is almost  $1/\pi(1 + m + \sqrt{m})$ . Following this analysis, two identical amplifier circuits in phase quadrature with corresponding power addition in the output stage are proposed as means of restoring the performance under a mismatch sufficiently for stereophonic radio broadcasting. Such an arrangement, often used in television transmitters for echo attenuation, has been tried experimentally in a UHF FM transmitter with a bridge circuit and a synthesizer-exciter adjustable in 10 kHz steps, also an antenna equivalent beside the VHF separating filter connected to the real antenna through a 300 m long feeder. The results indicate the feasibility of refurbishing "Dozhd'-2" transmitter stations for stereophonic as well as better-quality monophonic broadcasting. The necessary equipment are ARS-1 stereophonic modulators and FM exciters, in addition to which the feeder cables must be appropriately lengthened by a quarter wavelength. Proper tuning is needed for suppression of the oscillating voltage at the anode of the GU-33B transmitter tube. Figures 4; tables 1; references 9 Russian. [184-2415]

UDC 621.396.97:654.19.2

STEREOPHONIC SOUND TRANSMISSION OVER 3-PROGRAM WIRE BROADCASTING NETWORKS

Moscow ELEKTROSVYAZ' in Russian No 12, Dec 84 (manuscript received 6 May 83)  
pp 17-19

BAGLAROV, I. A.

[Abstract] Three basic methods of stereophonic sound transmission over 3-program medium-wave AM wire broadcasting networks are examined and compared. The first method is transmission of the two stereophonic signals A and B over separate sideband channels. The second method is double modulation;

amplitude modulation of the A+B sum signal and phase or frequency modulation of the A-B difference signal with the same carrier. The third method is quadrature modulation, with the two A and B carriers having the same amplitude but being  $2\phi = 90^\circ$  out of phase ( $\pm 45^\circ$  out of phase with the unmodulated carrier. This is the extreme case of channel separation, a  $2\phi = 0^\circ$  phase difference corresponding to the other extreme of monophonic transmission. Channel separation with any phase difference between modulated carriers is feasible, a decrease of the phase difference reducing the nonlinear distortion in a monophonic receiver but also lowering the signal-to-noise ratio in the A-B difference channel of a stereophonic receiver. A tradeoff has been reached with a phase difference  $2\phi = 30^\circ$  and appropriate structural modification of the stereophonic broadcasting system so that the width of the spectrum is retained in each of the three program channels, stereophonic transmission is compatible with reception over conventional 3 program loudspeakers, the stereophonic channels remain separated regardless of the "station amplifier - wire broadcasting network - home receiver" channel characteristics, and all three program channels remain available for three programs, two of which can be stereophonic and simultaneous. Figures 2; references 5 Russian. [184-2415]

POWER ENGINEERING

UDC 621.311.016.001.24

OVERLOAD ON INTERSYSTEM TIE

Moscow ELEKTRICHESTVO in Russian No 10, Oct 84 (manuscript received 24 Apr 84)  
pp 44-47

KOLONSKIY, T. V., candidate of technical sciences, Kiev

[Abstract] Overload on an intersystem tie, caused by turbine speed regulation and attendant boiler response of by power unbalance during and after faults or system partition, is evaluated from the standpoint of maintenance of static or dynamic stability by countermeasures such as load limitation or margin control. Slow overload is of particular concern, the fundamental second-order differential equation of transient-state rotating motion and power balance in a system with equivalent synchronous turbo-generator at the sender end static load at the receiver end being solved for this case with appropriate initial conditions. The proper coefficients are used in this equation to represent inertia, damping, and resilience. Calculations based on the solution yield both the power angle and the slip as functions of time, the essential information needed for overload protection. Figures 4; references 8 Russian.  
[150-2415]

UDC 621.313.32:621.314.26

GENERATION OF 10 Hz 3- $\emptyset$  CURRENT BY MEANS OF SINGLE-MACHINE SYNCHRONOUS FREQUENCY DIVIDER

Moscow ELEKTRICHESTVO in Russian No 10, Oct 84 (manuscript received 20 Jan 84)  
pp 61-62

ANISHCHENKO, Ye. I., candidate of technical sciences, Vinnitsa Polytechnic Institute

[Abstract] A single-machine 600 rpm 3- $\emptyset$  synchronous frequency divider with salient-pole structure is described which consists of a 10-pole synchronous motor energized by a 50 Hz voltage and a 2-pole synchronous generator

15 May 1985

delivering a 10 Hz current, both having a common field structure. The theoretical performance analysis of this frequency converter is based on calculation of the field-rotor characteristic, assuming a sinusoidal distribution of magnetic induction distorted by the fifth harmonic only, and of the stator-armature characteristics. A prototype was designed and built with two double-layer armature windings in  $60^\circ$  phase belts under an AM 71-4 induction-motor housing. The stator design constant is  $D_a^2 l / S = 10.4 \text{ cm}^3/\text{VA}$  for  $S = 875 \text{ VA}$  at  $\cos \phi = 0.8$ , or  $13.5 \text{ cm}^3/\text{VA}$  for  $S = 675 \text{ VA}$  with 20% voltage regulation and 2.5 power reduction factor. The prototype was run, after asynchronous starting of the underexcited motor (lagging power factor) from a 220 V 3- $\phi$  network, with excitation from a 50 Hz 3- $\phi$  network through a rectifier. It was used for starting a 4.5 kW induction motor and 4.8 kW d.c. generator set under no load. Such a single-machine frequency converter is much smaller and more economical than a 300 rpm 3- $\phi$  two-machine set consisting of a 20-pole synchronous motor and a 4-pole synchronous generator with the same rating. In the reverse direction it can operate as a frequency multiplier. The prototype was built and preliminary tests were performed with assistance of engineer V. K. Piven'. Figures 2; tables 1; references 4 Russian.

[150-2415]

UDC 621.3.011.4.001.24:517.512.3

## CAPACITANCE OF PAIR OF THIN SPHERICAL SHELLS

Moscow ELEKTRICHESTVO in Russian No 10, Oct 84 (manuscript received 25 Jan 84) pp 62-64

SHUSHKEVICH, G. Ch., Belorussian State University

[Abstract] The axisymmetric problem of electrostatics is formulated for a pair of conducting thin spherical shell segments which have been charged to a known constant potential each. The boundary-value problem for the Laplace equation reduces to paired sum equations in Legendre polynomials, on the basis of addition theorems which connect the solutions to that Laplace equation in different sets of coordinates, whereupon those sum equations are reduced to an infinite system of linear algebraic equations of the second kind. The capacitance is calculated accordingly for two configurations: 1) shells of unequal radii axisymmetrically parallel, smaller shell outside larger one; 2) shells of unequal radii forming an axisymmetric convex-convex pair, smaller shell inside larger one with aperture facing in opposite direction. Sixteen capacitors of each configuration are evaluated, corresponding to the 16 possible combinations of four arc lengths ( $90^\circ$ ,  $180^\circ$ ,  $270^\circ$ ,  $350^\circ$ ) for each shell. Figures 2; tables 2; references 7 Russian.

[150-2415]

UDC 621.313:537.312.62

# EXCITATION MODE OF CRYOGENIC MOTOR WITH CUT-OFF OF ONE POLE COIL

Moscow ELEKTRICHESTVO in Russian No 11, Nov 84 (manuscript received 21 May 84)  
pp 30-36

MILYKH, V. I., candidate of technical sciences, Khar'kov polytechnical  
Institute

[Abstract] The ultimate power and efficiency of reversible dc motors used in rolling can be increased by employing superconducting excitation coils. A serious design problem is the development of reliable superconducting excitation coils and the cryogenic system. One approach is based on individual cryogenic poles with a multipole motor, while retaining the standard electromagnetic circuit of a cryogenic motor except for active armature winding. The advantage of the individual pole cryostate is that if one fails, it can be replaced during operation at low cost from the reserve, while replacing the entire cryostate is difficult and expensive. Asymmetric transient processes affecting the entire excitation system occur when one of the pole coils is cut off, which causes overheating and other undesirable problems. Methods were developed for computing and analysing these processes in the cryogenic motor excitation system when one pole coil is cut off. A specific analysis was conducted for two circuits, but the proposed method can be applied to other circuits as well. This method was tested experimentally with a specially constructed six-pole dc motor of the P-153-8K type. Shorted wire loops were added in the pole circuit, and the asymmetric transient processes were modeled by cutting off the field of one coil. Figures 7; tables 1; references 16: 15 Russian, 1 Western.  
[160-12755]

UDC 621.317.441.017.001.24

# CALCULATION OF POWER LOSSES IN SUPERCONDUCTING AC SOLENOIDS

Moscow ELEKTRICHESTVO in Russian No 11, Nov 84 (manuscript received 07 Jun 83)  
pp 55-59

ALIYEVSKIY, B. L., candidate of technical sciences

[Abstract] Many superconducting magnetic systems such as those of electrical power generators are exposed to electromagnetic radiation including superconducting excitation coils of cryogenic turbo-generators, experimental solenoids, electromagnets of particle accelerators, etc. Inductors of unipolar ac generators can be made of superconducting coils fed by relatively low-power sources at stable frequency  $f \leq 1$  Hz. Such unipolar ac generators can be used for supplying power to stators of arc furnace electromagnetic mixers of molten metals where the generators functions as low frequency electromechanical amplifiers. Superconducting

ac solenoids with rectangular meridional cross section of the winding were used for computing the losses due to transverse harmonically varying induced magnetic fields. Computation methods are described and computations indicate that the superconducting solenoid size significantly affects the ratio of losses  $P_M/P_H$  due to  $B_M = \text{VAR}$  within the meridional cross section of the winding, where  $P_M$  are losses in the matrix of the multifilamentary superconductor,  $P_H$  are hysteresis losses, and  $B_M$  is the magnetic induction. For small size solenoids at  $f < 1$  Hz, the losses were  $P_H < P_M$  where the  $P_H$  peaked at  $f \approx 1$  Hz. For large superconductor windings  $P_H$  and  $P_M$  were commensurate and for  $f < 1$  Hz  $P_M > P_H$  is also possible. A comparison was made between the values of  $P_M$  and  $P_H$  obtained by the described method and known values. Some discrepancy was found because of the effects of the superconducting wire was not taken into account. Figures 2; tables 1; references 11: 10 Russian, 1 Western.  
[160-12755]

UDC 621.316.542.027.3.064.242.001.57

#### ADAPTIVE MATHEMATICAL MODELING METHODS FOR DEVELOPING AC AND DC GAS SWITCHES

Moscow ELEKTRICHESTVO in Russian No 11, Nov 84 (manuscript received 25 Jun 83)  
pp 48-52

YEGOROV, V. G., YELISEYEVA, T. A. and SERYAKOV, K. I., V. I. LENIN All-Union Electrotechnical Institute

[Abstract] Two methods are presently under development for designing arc control devices of gas-blown switches. One uses exact equations of gas dynamics and the other is based on the work of Kassi and Mayer. The two approaches are similar but the first gives only an approximate qualitative study of factors affecting switching properties, while an adequate description of the arc controlling device can be obtained with the second method, if the model equations are properly selected. Studies indicated that the application of adaptive mathematical arc modeling when designing ac and dc switches can be very useful but caution must be exercised when formulating the arc model and additional independent verification of its validity must be made, including accurate checking of the constituent parameters. This particularly concerns models where the time constant and power losses vs. arc resistance were determined from the current and voltage oscillograms obtained for the electrical breakdown. Adaptive modeling methods are applicable for ac as well as dc switches. For the latter case an accurate study is required of the dynamic properties of the arc in the region of small resistances, down to quasi-stationary values corresponding to the switching current. Figures 3; references 8: 4 Russian, 4 Western.  
[160-12755]

UDC [621.316.174:629.13].001.24

## SYNTHESIS OF ELECTRIC POWER DISTRIBUTION NETWORK FOR SELF-CONTAINED FACILITIES

Moscow ELEKTRICHESTVO in Russian No 11, Nov 84 (manuscript received 31 Jan 84)  
pp 20-24

TERESHCHUK, V. S., candidate of technical sciences, Kazan' Aviation Institute

[Abstract] Synthesis of the airborne electrical power distributing network is important for the design of independent power supply systems. Several papers were published earlier on the subject in which the primary distributing network was synthesized treating the secondary network as a group of individual receivers of electrical energy placed at specified locations. However, by means of automated design and development of airborne electrical equipment it was shown that both the primary and the secondary distributing networks must be examined as a single process when developing the network. Synthesis of the secondary network consists of first determining the composition of the non-power electrical structures, positioning individual units aboard the aircraft as well as topological problems of forming the network. The results are then applied for synthesizing the primary network, selecting and positioning the optimal number of the energy distributing devices and the wire-sizes of all sections of the primary and the secondary network are computed. These problems were examined and algorithms developed as an integrated part of the software for automated design. Feasibility of full implementation is based on experimental computations for determining optimal values for primary and secondary network wire cross sections. Programs were written in FORTRAN IV for use with the YeS series computer. The methods can be also used for manual computation of small-size networks for a single channel power supply system. Figures 1; tables 2; references 9 Russian. [160-12755]

UDC 621.316.1.027.5.019.3

## SELECTION OF SITES FOR ZONING RURAL ELECTRIC POWER DISTRIBUTION NETWORKS

Kiev ENERGETIKA I ELEKTRIFIKATSIYA in Russian No 3, Jul-Sep 84 pp 24-25

KRYSENKO, A. P., engineer, "Energoset'proyekt" Institute, Belorussian branch

[Abstract] Automatic protective relaying is the most effective method of reliability assurance in electric power distribution networks, maximum cost effectiveness being ensured by automatic zoning for automatic hookup to standby feeders at appropriate points. Here economic criteria for selection of zoning sites are defined as basis for analytical estimates applicable to rural electric power distribution networks. A network with uniform load distribution is considered, for simplicity, approximate locations of automatic zoning relays and automatic hookup switches being

determined to match a given network layout and known operating conditions as well as degree of automation. Even these rough calculations indicate already that the reliability indicator can be improved by as much as 15% by installing the automatic protective equipment in correctly selected sites. Figures 1; references 2 Russian.  
[180-2415]

UDC 621.316.722:621.315

OPTIMIZATION OF ON-LINE CONTROL OF TRANSVERSE REGULATORS IN 750/330 kV NETWORKS

Kiev ENERGETIKA I ELEKTRIFIKATSIYA in Russian No 3, Jul-Sep 84 pp 42-45

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[Abstract] Separately mounted transformers tapping into 750/330 kV autotransformers are used for transverse voltage regulation controlling the power distribution in closed 750/330 kV networks. In order to reduce the energy loss in these regulators, amounting to  $60 \cdot 10^6$  kW·h annually in the Donbass - Western Ukraine system alone, it is necessary to control them on-line. A method of such a control with optimum setting is proposed which combines relative simplicity with sufficient accuracy. The voltage magnitude as well as active and reactive power are measured on the high-voltage side only. However, subsequent identification and optimization of performance parameters are based on a network model which includes not only all high-voltage (750 kV) components but also equivalent impedances representing the medium-voltage (330 kV) components and referred to the 750/330 kV autotransformer busbars. The optimization program, typically the B-2/77 program, is based on relations for longitudinal and transverse emf components, active and reactive power, and power angle between voltage and emf at the transformer input - in accordance with circuit theory. It continuously yields the optimum step-down ratios and switch positions with minimum error and for maximum efficiency. The program has been particularized for and applied to four substations in the Southern Integrated Power Grid (Western, Dnepr River, Vinnitsa, Donbass). It already ensures 90% of potential energy saving and can be further improved for even more efficient and accurate control, automatic or manual in real time either way. Figures 1; tables 1; references 2 Russian.  
[180-2415]

UDC 621.315.048

AUTOMATIC CABLE BURN-THROUGH EQUIPMENT AUPK-1/10

Kiev ENERGETIKA I ELEKTRIFIKATSIYA in Russian No 3, Jul-Sep 84 pp 28-30

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[Abstract] New automatic equipment was developed and built for burn-through of faulty cable insulation as means of locating the fault. It operates with rectified current, its output voltage being regulated by the current deviation signal. The functional part of the equipment is an autonomous parallel voltage inverter bridge with a battery across one diagonal and a power transformer across the other diagonal. Three secondary transformer windings with different step-up ratios feed the faulty cable for three different burn-through levels through half-wave rectifiers and high-voltage disconnectors. The regulator part of the equipment is a pulse-width modulator which receives a control signal proportional to the actual burn-through current and compares it with the reference signal proportional to the preset burn-through level coming through adjustable resistors. The two modulator outputs are respectively connected to the gates of the two thyristors in the inverter bridge. The modulator thus controls the "open" period of both thyristors and correspondingly the output voltage, depending on the actual burn-through current, negative feedback being achieved by correcting the polarities of the two modulator input signals. The rating of this AUPK-1/10 equipment is maximum burn-through voltage 25 kV and maximum burn-through current 3 A, maximum afterburn current for fault location 40 A and maximum power drain 5 kW. Tests indicate that the time for insulation burn-through with this equipment does not exceed 10 min. Figures 4; references 4 Russian.  
[180-2415]

UDC 62-83:621.313.13-133.32(04)

EXPANDED SCOPE OF APPLICATIONS FOR ELECTRIC STEPPER MOTORS

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA in Russian No 12, Dec 84 (manuscript received 8 May 84) pp 81-83

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[Abstract] Electric stepper motors are widely used in automatic position control systems, specifically for discrete linear or angular displacements. While they surpass continuous drives in precision, where small displacements without error buildup are required, they are not adequate for high pickup repetition rates and for large displacements at high speed in an open-loop

configuration. A locally closed loop with position and speed feedback should solve the problem, but a conventional transducer mounted on the rotor limits the pickup repetition rate and adds to mechanical unbalance while also adding to structural and technological unwieldiness. Another solution is therefore proposed, namely utilizing the rotational emf induced in the stator windings. Each stator phase is connected to the output of the control device through the current coil of a transformer, one separate transformer being required for each phase, and another transformer winding in series with a resistance-inductance network equivalent to the stator winding is connected in series-opposing with that current coil. The control module includes an automatic switcher from positioning to continuous rotation, which receives signals from a starter generator for reliable starting of the motor under an inertia load and receives "forward" or "backward" input pulses for reversing the direction of motor rotation by appropriate action through a reversible pulse distributor. The position control loop is closed locally through a null sensor. A current limiter shunting the speed control device in series with the stator windings (transformers) limits and stabilizes the starting current and the positioning current, also allowing stall while the stator windings are energized. Such a stepper motor has all the favorable characteristics of a contactless d.c. motor in the high-speed range. Figures 1; references 3 Russian.  
[181-2415]

UDC 621.3.013.22.001.24:517.947.32

ASYMPTOTIC METHOD OF PERFORMANCE CALCULATIONS FOR SUPERCONDUCTING SUSPENSION WITH FIELD SHAPING SHIELDS

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA  
in Russian No 12, Dec 84 (manuscript received 26 Oct 82) pp 55-63

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[Abstract] An asymptotic method is proposed for calculating the performance of a superconducting quasi-spherical rotor suspended in a current-inducing magnetic or charge-inducing electrostatic field with a narrow clearance from a superconducting field-shaping shield. Considering the more difficult case of a simply-connected shield, the vector potential is represented not conventionally in terms of secondary current sources but in integral form describing the response of a superconducting sphere to primary currents in field coils. The problem is first formulated and solved as a generally three-dimensional one, then for the special case of thin shields forming a spherical array of belts or any other axisymmetric simply-connected figure around the rotor. Infinitesimal thickness of these shielding belts is assumed, as requisite for avoiding entrapment of the magnetic flux. The results can be used for design purposes such as calculating the necessary

rotor stiffness and limiting the drift torque due to asphericity of the rotor. With the calculations programmed for a YeS-1035 computer, the method was tested on a rotor made of niobium and weighing 70 kg with the magnetic field intensity at its surface not allowed to exceed the critical level of 1300 Oe. The maximum allowable current in the field coils was determined for each set of values of the geometric design parameters, as the ratio of that critical magnetic field intensity to the maximum actual magnetic field intensity at the rotor surface with a current of 1 A flowing in the field coils. Figures 1; tables 1; references 5 Russian.  
[181-2415]

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